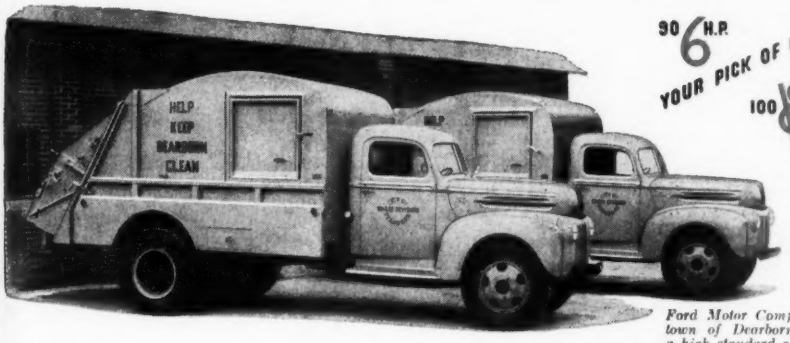
REGISTRATIONS *SHOW* IT—OPERATORS *KNOW* IT!

"FORD TRUCKS LAST LONGER!"



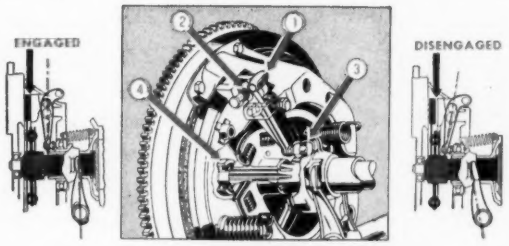
90 6 H.P.
YOUR PICK OF POWER
100 V-8 H.P.

Ford Motor Company's home town of Dearborn maintains a high standard of civic sanitation. These garbage packer bodies are by Gar Wood, the chassis conversion is Truckstell.

ONE big reason:

FORD CLUTCHES STAND UP!

Torque-transmitting capacity of Ford clutches increases with engine speed, because centrifugal force is harnessed to add *extra* pressure to that exerted by the clutch springs. Thus, slippage and wear are minimized. Three weighted, cam-action levers (1), due to centrifugal force, act upon the back of the clutch plate, forcing it ever more firmly into contact with the clutch disc. Needle roller bearings (2) on these pivoted levers, and pre-lubricated ball pilot and throwout bearings (3 and 4), reduce wear at these vital points and promote easy pedal action. No internal lubrication is required.



Ford

ONLY IN A FORD TRUCK do you get your choice of two great engines, the 100-H.P. V-8 or the 90-H.P. Six. ONLY FORD brings you all these long-life features: Easy-turning, rolling-contact steering gear, with triple roller bearings—weather-proofed Hi-Volt ignition—positive control of engine temperature for swift warm-up, protecting bearings, cylinders, pistons, rings and valve mechanism—rear axle design which takes all weight-load off the axle shafts (¾-floating in half-ton units, full-floating in all others)—all told, *more than fifty* such endurance-assets!

Where can so few truck dollars get you so much *truck value?* Ford endurance-engineering explains why FORD TRUCKS LAST LONGER . . . why the average age of all Ford Trucks in use is nearly 9 years . . . why 7 out of 11 of all Ford Trucks built since 1928 are still in use! Only the costliest makes match this record. No wonder that demand for new Ford Trucks is forcing production schedules higher and higher. See your Ford Dealer now!

FORD TRUCKS

MORE FORD TRUCKS IN USE TODAY THAN ANY OTHER MAKE

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 63-65*

The Editor's Page

1947—Time to Look Forward

During the war it was fashionable, often necessary, and patriotic, to utilize makeshifts, and to get along without. That time has passed, and it is time for better, and still better, engineering. It is time to look forward to the things we can do, and not backward to the days of "make do." It is time to shake off the inhibitions that all of us occasionally are subject to, and to get down to the business of taking adequate care of the future, not talking about the past.

A year ago this magazine determined to look ahead. It determined not to publish articles that glorified makeshifts and told how to do without, or how to postpone needed work. It has stuck to that determination, and for the coming year it pledges more of the same. It believes in continued research for and development of better methods and equipment; sound but bold and forward-looking engineering; willingness and even eagerness to take advantage of new ideas and new methods; and in doing the job right in the first place. It believes these are the components of better public works engineering and of better service to our communities.

Why Mechanization Is Needed in Public Works Engineering

This country, for all practical purposes, has ceased the production of the so-called common labor that, in the years past, did the heavy work of building highways, laying sewer and water pipe, and constructing other public works facilities. There are two alternatives for the future: To import labor from foreign countries, or to rely increasingly on machines to do the work.

It does not seem to us that this country will ever again permit any large tide of immigration and that we are, in actual fact, faced with the necessity of increasing our use of machinery. Municipalities and counties have been slower than industry to recognize the need for labor-saving equipment for construction, operation, and maintenance, and have generally hesitated to rely on mechanization to any marked extent. Perhaps the pressure for employment, so often acute in the past, has set city and county officials in a mold of bygone days. It is time that they looked hard facts squarely in the face, and realized that there is but one answer to their needs, and that answer lies in the widest possible utilization of modern equipment for public works.

Reducing Grade Crossing Accidents

In a recent issue, we pointed out that the elimination, a few years ago, of some of our major grade crossings has resulted in a marked decline in grade-crossing accidents. For the last year of record, there were some 14% fewer such accidents than there were 20 years before, while on the basis of present-day automobile and train mileage, the accident rate has been reduced 65%.

It is obviously out of the question from a financial viewpoint to eliminate all grade crossings, but they ought to be made as safe as is humanly possible; and for the most part this can be done in an acceptable and effective manner without spending much money. A safe approach, with ample width of roadway, adequate sight distance, and positive and modern devices for warning and stopping the motorist in plenty of time, are the minimum requirements. All of these safeguards are within reach of our road-builders, and they should make full use of them. The public is entitled to this protection.

Making Undrinkable Water Drinkable

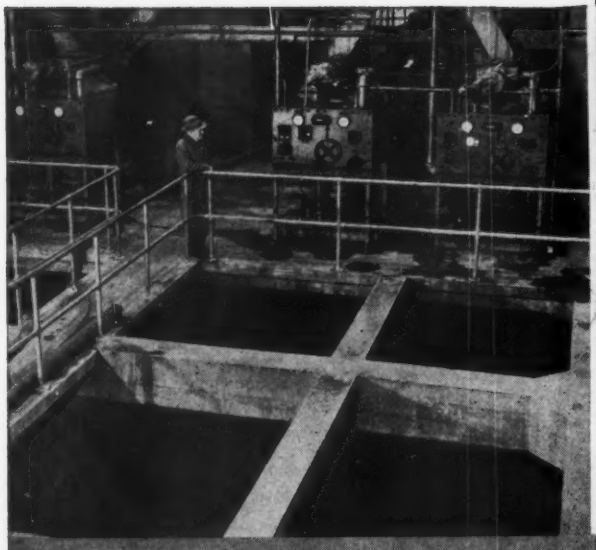
One of the headaches of the war for those charged with the procurement of water for troops was that many phases of the war occurred in areas where the water supplies available locally were unfit for consumption due to salinity, high total solids, excessive sulphates, temperature, alkalinity or hardness. At one installation in this country water had to be hauled 15 miles; at others long and costly pipe lines had to be constructed. Overseas, under such conditions, reliance had to be placed on distillation or on shipping in water.

The development of ion-exchange methods on a workable scale should prove a great benefit, not only to the army and navy if another emergency should arise, but to many communities in the United States where local water supplies are either unsatisfactory due to the factors mentioned above, or are marginal in respect to these qualities. The cost of treating water containing 2500 or 3000 ppm of total solids is still high, but such water can be treated at a cost that is often highly favorable in comparison with other methods of supply; and it is likely that with experience and further developments, the present-day scale of costs can be very considerably reduced. More research and more experience are needed, but the outlook is promising.

Parking Meter Receipts Ought to Be Used for Traffic Improvements

Experience has shown that the use of parking meters doubles or triples street parking capacity during shopping hours. They are not the final answer to the parking problem. However, pending the provision of adequate off-street parking facilities, they are most helpful, and they yield a good profit. This profit ought to be, but rarely is, utilized for providing traffic improvements, including off-street parking facilities. In fact, according to a recent survey by the American Public Works Association, of 277 cities surveyed, only 39 or about one-seventh use meter revenues for traffic improvements; and only 7, or about 3%, use these revenues for providing off-street parking facilities. In the great bulk of cities, actually in 81% of them, parking meter revenues go to the general fund.

The installation of parking meters is probably the most effective emergency step that can and should be taken to meet immediate needs. Their use should be supplemented by vigorous steps to provide additional parking facilities for shoppers; and the income from the meters, over and above that required for their maintenance, ought to be devoted entirely to a sound program for improving the parking and traffic situation.

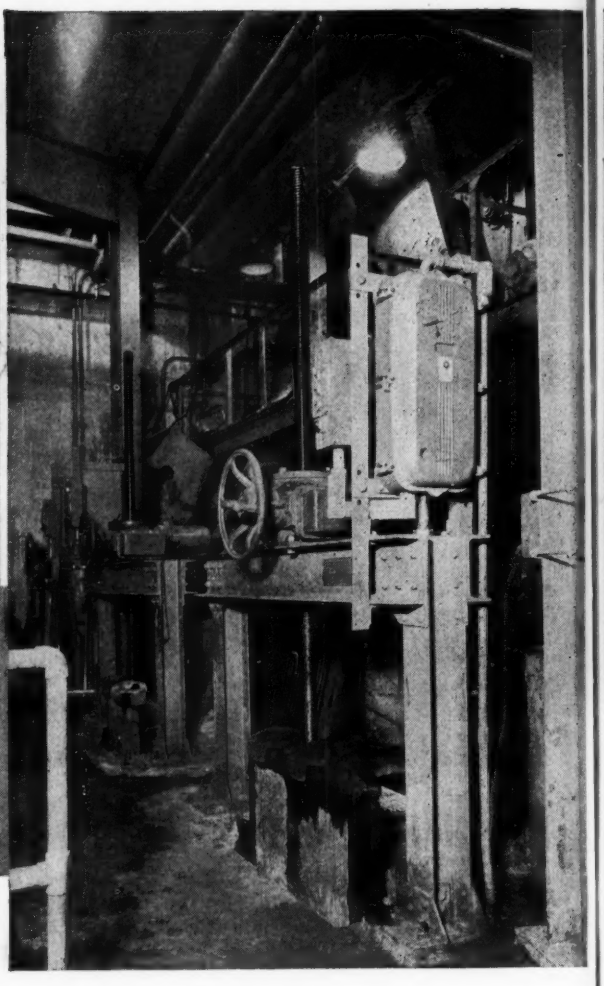


Where Everdur Serves in New Jamaica Plant...

In 5 hydraulic sluice gates: Bolts, facing strips and other mounting parts. Also copper-silicon alloy 4¼ inch diameter operating stem.

In two inclined 20-foot diameter revolving disc screens: Slotted Everdur plates for cone and disc.

In four grit ejectors: Everdur for gate slides and cylinders, piston rods, valve stems, bolts and nuts.



Everdur provides long life for Jamaica's Grit Ejectors

FOUR GRIT EJECTORS of 40 cu. ft. capacity each, with 12-inch inlet and 8-inch discharge slide gates, are in continuous service at the Jamaica Sewage Treatment Plant of the City of New York.

All gate slides and cylinders, piston rods, valve stems, operating gear, bolts and nuts are of Everdur*. These copper-silicon alloys of The American Brass Company were selected by Krajewski-Pesant Mfg. Corporation, designers and fabricators of the equipment, because of the high strength, workability and weldability of these alloys, and their high resistance to many types of corrosive gases and liquids.

For detailed information on Everdur Copper-Silicon Alloys in sewage and water works service, write for Publications E-11 and E-5.

*Reg. U. S. Pat. Off. 46219

ANACONDA

Everdur

COPPER-SILICON ALLOYS

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut

Subsidiary of Anaconda Copper Mining Company

In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

INTERNATIONAL *Diesel*

Maintains Municipal Dump at Minimum Cost

The amount of earth that can be pushed around with any size International Diesel Crawler is ideal for leveling and maintaining most municipal dumps.

Here, a city of 68,000 on the shores of Lake Michigan keeps its dumping areas in good condition with a dependable and economical International TD-6.

Refuse is brought to the site by dump trucks and the crawler distributes it, covers it with earth and levels it off. Considerable land is thus reclaimed along the eroded shoreline. Properly buried refuse becomes a municipal asset.

International Diesel Crawlers, Engines and Power Units are obtainable through the International Industrial Power Distributor near you. Check with him on the models now or soon to be available.

Industrial Power Division
INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue Chicago 1, Illinois

Tune in James Melton on "Harvest of Stars" every Sunday; NBC Network

INTERNATIONAL INTERNATIONAL HARVESTER ***Power*** CRAWLER TRACTORS POWER UNITS DIESEL ENGINES WHEEL TRACTORS

When you need special information—consult the classified READERS' SERVICE DEPT., pages 63-65

UNDER CITY STREETS, Transite saves by permitting narrower trenches, reducing disturbance to pavement. Fast assembly minimizes traffic tie-ups.

IN AGGRESSIVE SOILS, Transite guards against destructive corrosion. Thousands of installations prove its stability under a wide range of conditions.

IN THE TRENCH, man-hours are cut. Fewer men are needed for handling. Most sizes can be installed without mechanical handling equipment.

IN SUPPLY LINES, Transite's immunity to tuberculation means lower pumping costs. Its high flow capacity (C-140) is tuberculation-proof.

AS DISTRIBUTION MAINS, Transite Pipe cannot cause "red water." Its high corrosion resistance means low maintenance over the years.

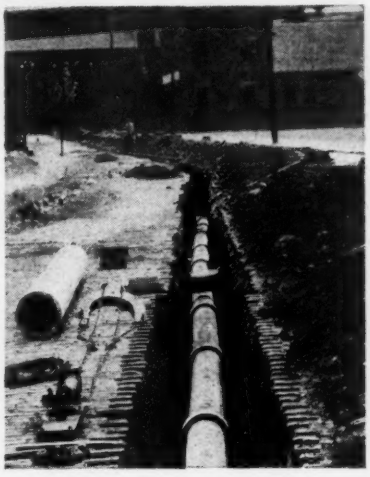
Wherever it's used . . .

AS YOU CAN SEE—Transite Pipe is unusually light in weight . . . easily handled and unloaded. Installation takes less time . . . and fewer men.

JOHNS-MANVILLE JM PRODUCTS

When you need special information—consult the classified **READERS' SERVICE DEPT.,** *pages 63-65*

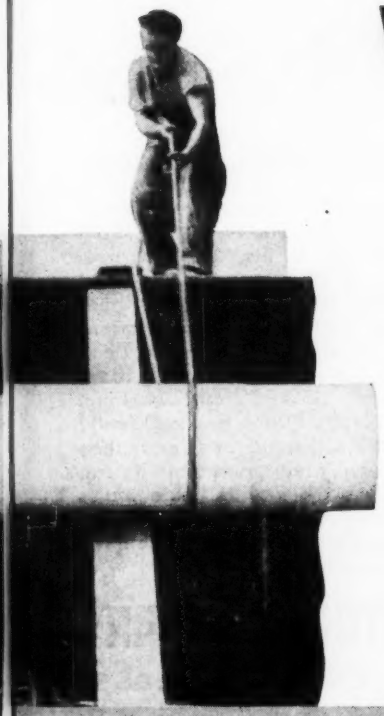
ON CURVES and in hilly terrain, Transite Pipe's flexible Simplex Coupling permits up to 5° deflection at each joint without use of fittings.



UNDER HEAVY TRAFFIC the Simplex Coupling provides a flexible joint that effectively withstands vibration—absorbs the shocks of heavy vehicles.

AT THE JOINTS, Simplex Couplings mean quick, easy assembly. They safeguard against underground leakage and undermining of supporting soil.

TRANSITE PIPE HOLDS DOWN WATER LINE COSTS



WITH an eye to *future economy* as well as *present-day efficiency*—thousands of forward-looking communities are using TRANSITE PRESSURE PIPE—in both water transmission and distribution lines.

Made of asbestos and cement, this tough durable pipe saves installation, operating and maintenance costs.

Light in weight, it is easily handled. The Simplex Coupling permits quick assembly . . . forms tight yet flexible joints. Highly corrosion-resistant, this modern pipe withstands aggressive soils. Because Transite's high carrying capacity (C=140) can never be reduced by tuberculation, pressures are higher, pumping costs lower . . . an added margin is provided for future water needs.

For details, write for Brochure TR-11A. Address Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville TRANSITE PIPE

When you need special information—consult the classified **READERS' SERVICE DEPT.**, *pages 63-65*

Clearing out a snow-bound town . . . *fast*

One Haiss snow loader does the work of 80 men, and handles up to 15 cubic yards a minute.

Loading high-sided trucks by hand is back-breaking, slow, expensive. But with a Haiss snow loader it's a modern mechanized operation, faster, cheaper, and more dependable.

This machine gets an amazing amount of work done because it is a positive digger and conveyor, operating on the continuous principle. Many communities run their machines all day and all night.

It's a glutton for light snow. And it's the best loader for hard and frozen snow because it is the only machine that digs upward as it loads. This is the loader you can depend on when the going is tough.

Our nearest sales representative will gladly arrange for you to see one in action.

Haiss is now a wholly-owned subsidiary of Pettibone Mulliken Corporation of Chicago. With new management and much larger resources, Haiss can now do a still better job for its customers . . . better machines and servicing, larger production, quicker deliveries.

Haiss specializes in equipment to load bulk materials . . . sand, gravel, stone, coal, topsoil, snow, etc.

Its machines are money-makers for their owners.

George Haiss Manufacturing Co.
139th St. & Rider Avenue
New York 51, N. Y.

WILLOW FREEWAY, first part of the $250,000,000 program to relieve traffic congestion in Metropolitan Cleveland, is a 1.6 miles long project requiring the moving of 1,245,000 cu. yds. of fill and using 15,848 ft. of **Clay Pipe.**

BIG SAVING in time is gained when traveling the wide, new Willow Freeway (shown by heavy white line) as compared with old route through congested districts (dotted line). Savings gained by using **Clay Pipe** can't be pictured so easily, but they show up in long, trouble-free service that makes **Clay Pipe** cost far less in the long run. For this project, work is being executed by the State of Ohio Highway Dept., Perry T. Ford, Director of Highways. In charge is Robert J. Edwards, Asst. to Chief Engineer; Walter Anderson, Div. Construction Engineer. Contractor for first section is Lombardo Bros. Construction Co., Cleveland; W. P. Tooley, Chief Engineer; Edward Chadeayne, Job Engineer.

LOOKING AHEAD . . .

MODERN EXPRESS HIGHWAY DEPENDS ON **CLAY PIPE** DRAINAGE

CLAY PIPE NEVER WEARS OUT!

With an eye to the future, the new Willow Freeway is designed to give tomorrow's traveler a shorter, speedier southern entrance to Cleveland. And with careful thought of the future, it is being built with drainage pipe of CLAY . . . the material so impervious to all kinds of corrosion, rust and decomposition that it *never* wears out! In bridge abutments, retaining walls, and wherever extra-heavy loads were encountered in the Willow Freeway, Extra-Strength Clay Pipe was specified. Engineers are finding increasing use for Extra-Strength Clay Pipe on all types of highway, airport, railroad and construction jobs. Extra-Strength Clay Pipe is *dependable* because it stands up under extra-heavy live and dead loads, and it is *economical* because it eliminates cradling costs.

NATIONAL CLAY PIPE MANUFACTURERS, INC.

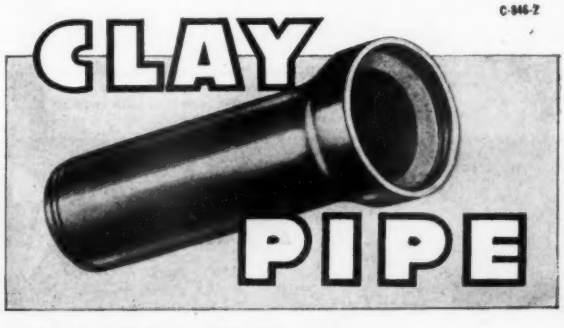
111 W. Washington St., Chicago 2, Ill.

522 First National Bank Bldg., Atlanta 3, Ga.

1105 Huntington Bank Bldg., Columbus 15, Ohio

571 Chamber of Commerce Bldg., Los Angeles 15, Calif.

C-946-Z



When you need special information—consult the classified **READERS' SERVICE DEPT.,** *pages 63-65*

PUBLIC WORKS MAGAZINE . . . January, 1947

VOL. 78. NO. 1

An Easy to Use on-the-Job Training Program for Your Highway Personnel

An outline for an on-the-job training program for state, county or city personnel, covering the elements of highway and street design, construction and maintenance. First of a series.

By the Editors of PUBLIC WORKS Magazine

It is the purpose of this text to provide an outline for training, furnish appropriate references, and indicate suitable instruction aids. So far as possible, the illustrations herewith have been selected so they may be used for slides or enlarged for charts. While references are made only to the texts listed below, there are additional valuable sources of material, some of which will be mentioned in the text. Addresses of sources are:

Highway Design & Construction, a textbook, by Arthur G. Bruce, International Textbook Co., Scranton, Pa. Referred to hereafter as *Bruce*.

American Road Builders' Ass'n, 1319 F St., N. W., Washington, D. C., various Technical Bulletins. Referred to hereafter as *ARBA*.

Highway Research Board, 2101 Constitution Ave., Washington, D. C., annual and other reports. Referred to hereafter as *HRB*.

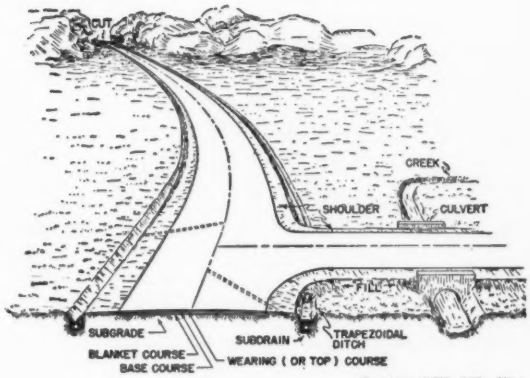
Public Roads Administration, Washington, D. C., various publications. Hereafter referred to as *PRA*.

Armco Drainage & Metal Products, Inc., Middletown, O., publications relating to drainage and subdrainage. Hereafter referred to as *Armco*.

The Highway and Airport Manual, 1946, published by this magazine.

Definitions and Nomenclature

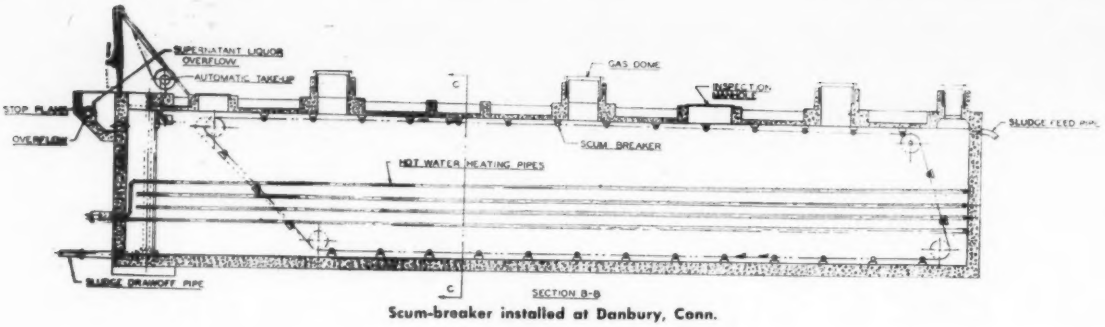
Some of the terms used in highway work are listed herewith; others will be introduced as needed to make the text clear; *Cross-section*, a vertical view of the shape of the road taken perpendicular to or across the center line; *course*, a horizontal layer of the road material parallel to the foundation or subgrade; *foundation*, the material on which the base course or surface course is laid, which may be natural earth or a reinforced support; *subgrade*, the surface of the foundation, but by common usage generally the top 6 to 12 inches of the foundation; *base course*, the course or material between the subgrade and the surface course; *surface or wearing course*, the layer of material in contact with vehicle wheels; *roadway*, that portion of the road structure within the right-of-way; *traveled way*, generally the portion normally used for traffic, or the paved or surfaced width; *shoulders*, the portion between the edge of the surfacing and the ditch slope; *drainage*, everything necessary to remove water from, along or beneath a road; *crown*, the difference in elevation between the center line and outside edges of a road; *superelevation*, the difference in elevation between the outside and inside of the traveled way at a curve; *cut*, lowering the road foundation; *fill*, adding material to raise the level of the road foundation; *alinement*, direction of a road; *tangent*, any straight section of a road; *curve*, any portion of a road joining two tangents; *profile*, the line of intersection of the road and a vertical plane; *grade*, the rate of ascent or descent of the road, in per cent or in feet per 100 ft.; *grade line*, a line along the center of the road defining the top surface profile.



Courtesy OCE, WD, USA

Some of the elements of a highway.

Turn to pages 29 to 32 for the remainder of this first article to help train your highway personnel.



Scum-breaker installed at Danbury, Conn.

How Scum Breakers Aid in Sludge Digestion

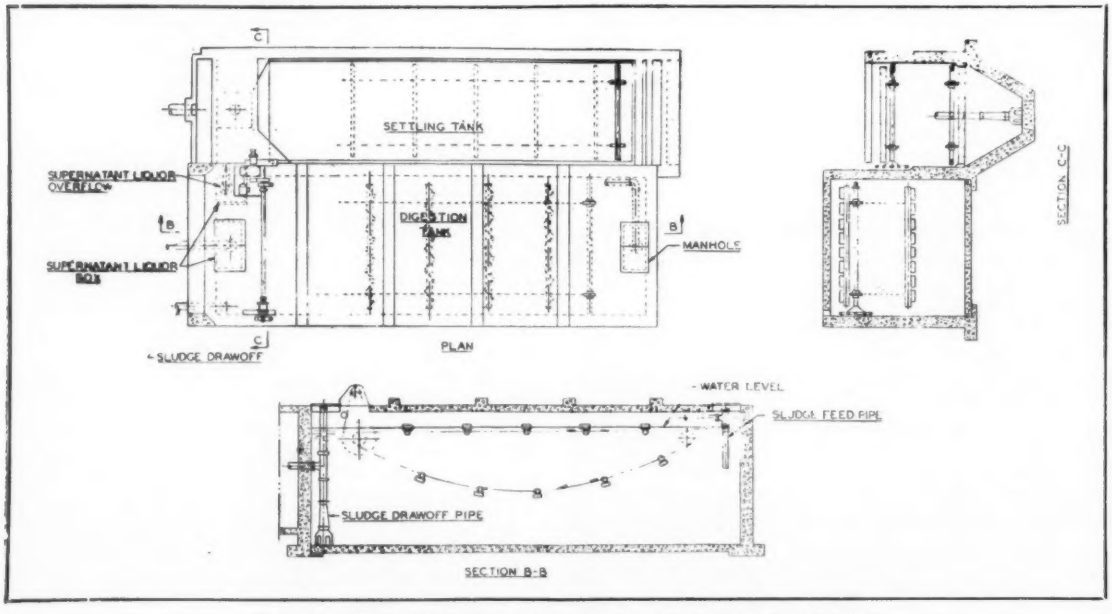
Where sludge digesters operate under difficult conditions, as with certain industrial wastes, scum breakers have demonstrated a high degree of usefulness.

By J. J. GILBERT
Engineer in Charge, Sanitary Engineering Division, Link-Belt Co.

AT MANY sewage treatment plants, digestion tank capacity is a critical factor, not only in relation to the digestion of the sludge, but also to the sewage treatment process itself. In order to produce a well-digested sludge and a relatively clear supernatant liquor, adequate digester volume must always be provided. However, in some cases even though the desirable theoretical volume of digester capacity has been provided, the actual useful capacity has been materially reduced by the formation of heavy non-digesting scum mats.

The need for preventing scum formation in sludge digestion tanks depends largely upon local conditions. Scum breakers are a definite asset in the operation of digesters handling sludge from wool-scouring, felt, packing house and many other industries. In any plant handling domestic sewage or domestic sewage and industrial wastes where the scum may form, dry out and become hard, scum breakers will eliminate much hand labor for breaking up this hard surface.

At Danbury, Conn. the sewage contains large quantities of hair from the hat manufacturing plants of that city. One of the digestion tanks at this plant is rectangular and is equipped with a Link-Belt scum breaker. The tank is heated and gas is collected. In this tank, which is comparatively long and narrow, the sludge enters at one end and is withdrawn at the bottom of the other end. The scum breaker consists of two parallel strands of endless chain to which are attached scum breaker flights spaced 10 ft. apart. The equipment is operated 24 hours a day so that the hair will not form a hard mat on the surface. At



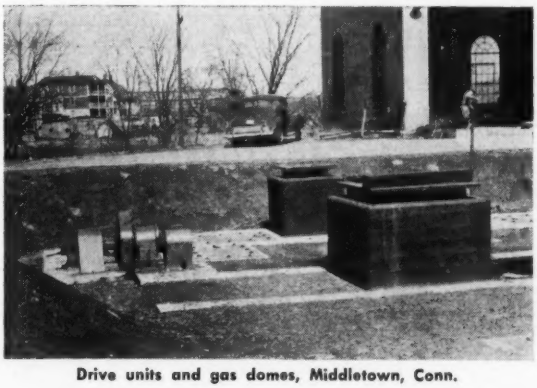
Combined settling and digestion tanks at Waverly, Va., showing scum-breaker.

intervals, the hair that will not digest and submerge is removed through a manhole at the influent end of the tank. The digester piping is arranged so that the supernatant liquor automatically overflows as sludge is pumped into the digester.

In a similar installation in Middletown, Conn., a scum breaker is installed in a tank 16 ft. wide, 15 ft. 8 in. deep and 83 ft. 3 in. long. Operation is by a 1 h.p. motor. A chain drive in a dry well is connected to a head shaft extending through a stuffing box in the tank wall, which insures a gas-tight connection.

At Hasbrouck Heights, N. J., an average of 9,000, and up to 15,000, cu. ft. of gas are collected daily from a population of 8,000. A 14-inch space between the sludge level and the underside of the roof is used to store the gas under a maximum pressure of 10 ins. of water. No sludge mat has ever formed in these tanks and it has never been necessary to remove any scum. The sludge is well digested, containing from 50% to 60% ash.

The sewage treatment plant at Waverly, Va., serves

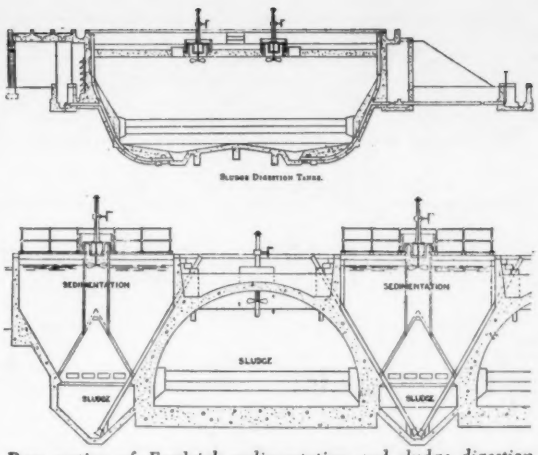


Drive units and gas domes, Middletown, Conn.

a population of 2200. It is so designed that the settling tank and the digestion tank have a common wall. The settling tank is equipped with a Link-Belt sludge collector and the digester with a Link-Belt scum breaker. Because of the compactness of this plant, the same 1 h.p. drive unit can be used to operate the sludge collector and the scum breaker. This scum breaker has only two upper shafts, and no attempt is made to convey or mix the sludge on the floor of the tank. The collector and the scum breaker are operated about 30 minutes daily, and after nine years of operation no mat has ever formed on the surface of the sludge even though it is 18 ins. below the roof and is exposed to the air. Gas is not collected at this plant. The plant at Tappahannock, Va., is similar to the Waverly plant.

At the Radford, Va., Ordnance Plant, which was constructed in 1941, the digestion tank is equipped with a Link-Belt scum breaker. The sludge is pumped into one end of the tank and withdrawn at the other. The scum breaker, traveling at the speed of 1 ft. per min., conveys the scum to the influent end of the tank where it is submerged and the entrained gases released by the action of the flights. This permits the broken-up scum to settle.

So far only rectangular digestion tanks have been discussed. Scum breakers can also be installed in circular digesters, and the design permits economical roof construction due to the supports provided by the posts. Experience has shown that if a path through the center of the tank is kept free from scum, the scum



Part section of Eastleigh sedimentation and sludge digestion tanks. Above, longitudinal section of digestion tank.

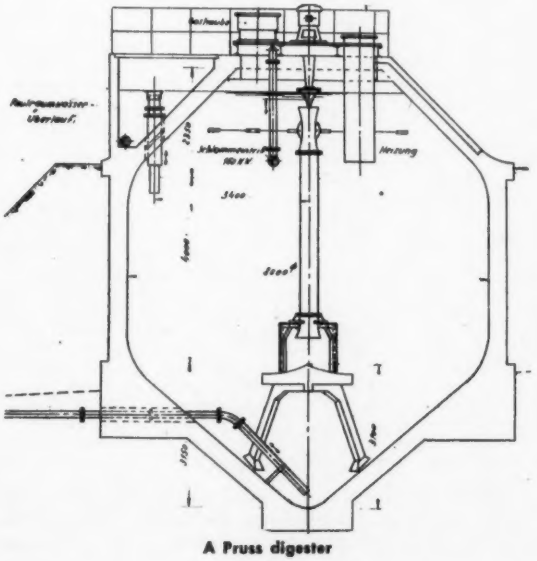
forming in other areas tends to float or will be pushed into the path of the scum breaker. The general design of equipment for circular tanks is the same as for rectangular tanks.

In the summer of 1945 as a special representative of the Surgeon General of the U. S. Army, the writer examined many sewage treatment plants in Germany and England. It was noted that a number of the digestion tanks in these countries were provided with equipment or devices for preventing scum formation.

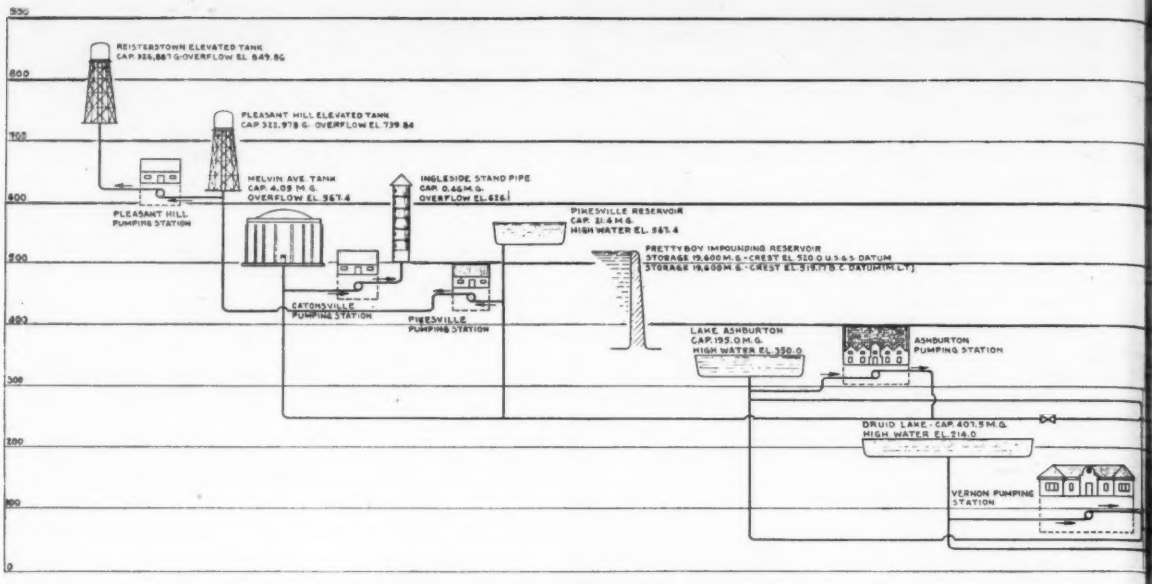
In the digestion tanks at Stuttgart, Germany, the heating coils are arranged in a circular cage and rotated to break up the scum mat and mix the top few feet of sludge. It is common practice in Germany to elevate the sludge from the settling tanks by means of air ejectors. The Passavant Co. has developed a scum breaker which consists of two nozzles. The raw sludge enters the digestion tank through these nozzles and the discharge of the sludge causes the nozzles to rotate, breaking up the surface scum.

The Prüss type of digester is familiar to many because of the experimental work done by C. E. Keefer at Baltimore. Keefer operated one digester with a

(Continued on page 38)



A Pruss digester



Hydraulic diagram of the Baltimore water system.

Results of the Control of Water Quali

By Edw. S. Hopkins, Associate Engineer
and
S. Everett Edwards, Senior Assistant Superintendent of Water Treatment

Bureau of Water Supply, Department of Public Works, Baltimore, Maryland.

THE 1946 United States Public Health Service drinking water standards[4] were voluntarily accepted in January 1946 by the American Water Works Association as standard for all public water supplies. These standards include the requirement that:

> "The water supply system in all its parts should be free from sanitary defects and health hazards, and all known sanitary defects and health hazards shall be systematically removed at a rate satisfactory to the reporting agency and to the certifying authority. Approval of public water supplies by the reporting agency and the certifying authority will be conditioned by the existence of: . . .
>
> A continuing program to detect health hazards and sanitary defects within the water distribution system.
>
> For the purpose of these Standards, responsibility for conditions in the water supply systems shall be considered to be held by:
>
> The water purveyor from the source of supply to the connection to the customer's service piping. . . .
>
> The bacteriological examination of water considered under this section shall be of samples collected at representative points throughout the distribution system.
>
> The frequency of sampling and the location of sampling points on the distribution system should be such as to determine properly the bacteriological quality of the water supply. The frequency of sampling and the distribution of sampling points shall be regulated jointly by the reporting agency and the certifying authority after investigation by either agency, or both, of the source, method of treatment, and protection of the water concerned."

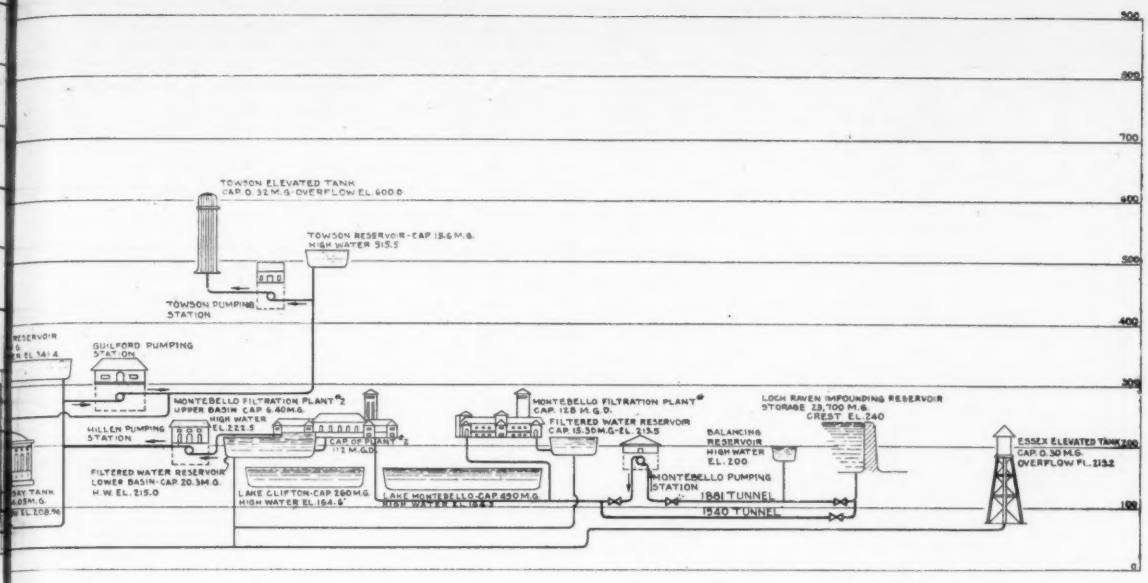
These standards established the minimum number of bacteriological samples to be taken from the distribution system for the examination of Coliform organisms, based upon the population served. For a city the size of Baltimore 300 samples are required monthly. This portion of the standard has been consistently complied with by the Bureau of Water Supply and the Baltimore City Health Department since 1925. Some 182 samples are tested each month by the Bureau of Water Supply; 114 by the Baltimore City Health Department and 39 by the Maryland State Department of Health. In addition, 600 samples are examined each month from the clear water basins at the Filtration Plants prior to admission of the water into the distribution system.

Corrosion.—It is recognized that corrosion control is a factor of water quality in the distribution system, but since this subject has many ramifications, it will be discussed in a future paper.

Cross Connection Elimination Program

To prevent contamination of the distribution system, the Bureau of Water Supply on December 7, 1929 promulgated the following regulations concerning cross connections.

> "No water pipes or conduits shall be installed or permitted to exist which are or may be physical connections between pipes or conduits supplied with water from the water mains of the Bureau of Water Supply and
>
> (a) Any system of piping containing fluids or gases from other sources, or
>
> (b) Water which has been supplied from the water mains of the Bureau of Water Supply and which has become polluted or is subject to pollution.
>
> Disregard of proper notice from this Bureau of the existence of such a connection and refusal to make the necessary changes to protect the purity of the water will



the Baltimore Distribution System

A critical study of the ability of a large and complicated water system to meet the USPHS drinking water standards. Chlorination procedure and sampling program. Results.

be penalized by shutting off the water supply service and disconnecting it from the water distribution main.

These regulations apply to all systems of piping carrying potable water from the mains of the Bureau of Water Supply of Baltimore in Baltimore City, Baltimore County and Anne Arundel County."

From 1926 to 1928 inclusive, some 2230 cross connection investigations were made and 67 connections to non-potable water supplies eliminated. During 1927 a comprehensive study was made of all swimming pools served by the system, all existing direct cross connections were broken, and systematic inspection was continued for many months. In 1929 a city-wide cross connection survey was made comprising some 1720 inspections. Until 1933, an average of 60 yearly inspections were made. In compliance with a legal ruling, cross connection control reverted to the City Health Department in 1933. From 1933 to 1945 the Health Department has prevented or corrected an average of 1138 cross connections each year, of which 74 were in industrial plants.

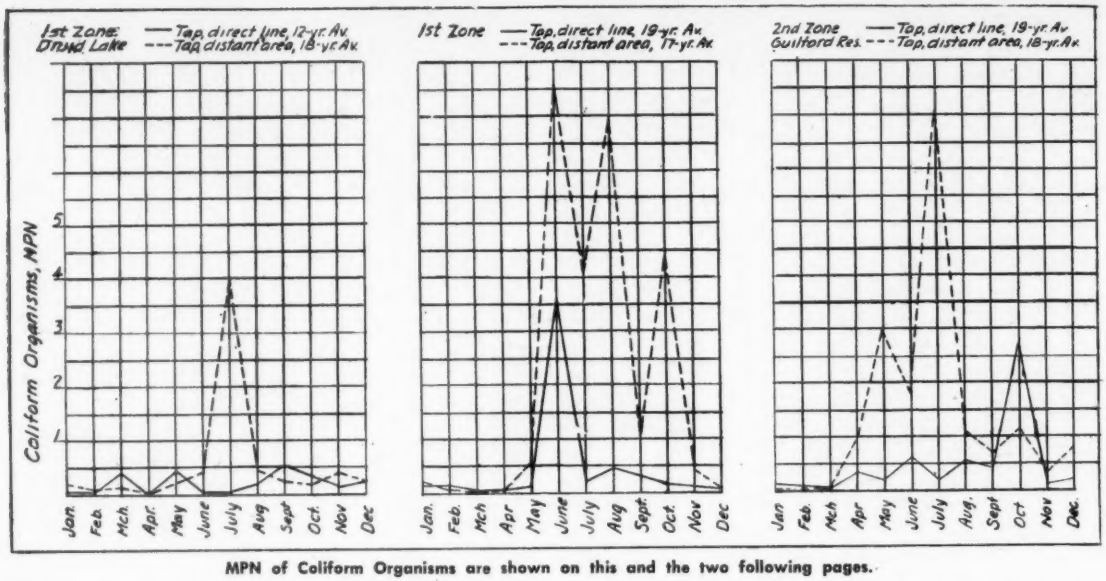
The Distribution System

Water from the two filtration plants is delivered to the distribution system by gravity and to areas at higher elevation than the plants by subsequent pumping and use of open balancing reservoirs. The system is divided into several service zones. The low service area below elevation 100 obtains its supply from the Montebello Filters and from Druid Lake which is directly interconnected to the plants. The second zone is between elevation 100 and 250. It is supplied by pumping from the low service zones into Lake Ashburton and Guilford Reservoir which serve as distribution reservoirs for this area. The third zone is between elevation 200 and 450. It is similarly supplied by pumping from the second zone into the Melvin Ave. Tank and the Towson and Pikesville Reservoirs. Water from the third zone is pumped into the Catonsville, Towson, Pikesville and Reisterstown Tanks which maintain the supply in the fourth zone. During warm weather periods, algae growths, present in the open reservoirs, are held to a minimum by semi-monthly applications of copper sulphate to the water surfaces, using 0.12 to 0.24 ppm., depending upon the concentration and type of micro-organisms present.

Secondary Reservoirs

Automatic chlorination of all water discharging from the open secondary reservoirs to the distribution system was instituted at Pikesville Reservoir in Jan., 1936; Druid Lake in Jan., 1938; Lake Ashburton in Aug.; 1939; Guilford Reservoir in Aug., 1940; and Towson Reservoir in Aug., 1942. The chlorinating stations[3] [8] are so designed that chlorine is automatically and continuously applied in predetermined dosage to the water flowing or being pumped from the reservoirs. The water entering Guilford Reservoir and Lake Ashburton is also chlorinated. Sufficient residual concentration is maintained at the Guilford Reservoir that additional chlorination of water discharging from it is not required during the winter when it is at low temperature.

Standard, commercial, automatic, vacuum solution-feed type equipment is in service. This is actuated by



MPN of Coliform Organisms are shown on this and the two following pages.

differential conveyors which vary the chlorine dosage in proportion to the flow of water. The chlorine cylinders are maintained on scales with recording weight devices. The volume of water leaving the reservoirs is obtained by visual inspection of manometer gauges, except at Ashburton Station, where the flow is recorded with a Venturi meter. Residual chlorine concentration is based on field "flash" tests and the final control is on weekly testing for coliform organisms. The rate of chlorine application is changed from time to time depending upon the adsorption of the gas by the water in each reservoir.

The chlorination stations are located in areas of better type housing. Their superstructure is of brick construction with concrete substructure and they make a very pleasing appearance as shown in the accompanying photograph.

Bacteriological Control

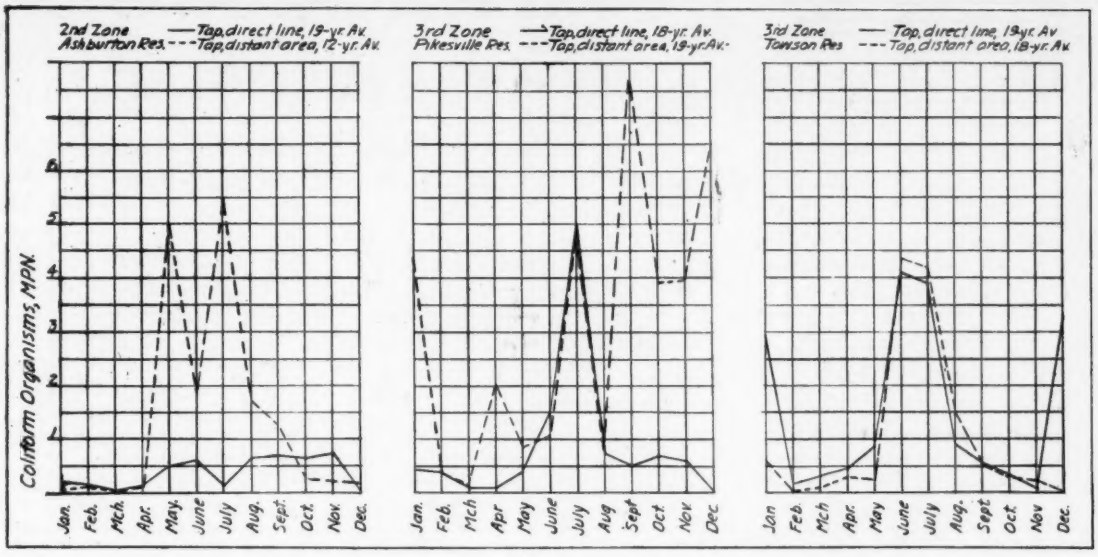
In a recent article, Wilson[8] states "It is safe to say that there is no water supply in the world which does not contain sufficient food to support active bacterial growth." Soluble organic and inorganic salts utilized by many species of bacteria are always present. It must be also recognized that the average chlorine dosage does *not* kill the higher organism such as yeast and molds. Daily testing of the water entering the distribution system during 1937 by this laboratory, using Sabourard media and Worth media, showed that these micro-organisms did not increase during the periods of warm water. This factor is of significance when it is recognized that this type of organism is a habitat for the B. coli group as well as a possible source of food. Also, contrary to expectation, these organisms did not multiply in the system.

An investigation of slime forming bacteria in paper mill waters by J. R. Sanborn[5] disclosed that coliform bacteria are the principal species present. "Out of 175 samples of slimes examined for coliform bacteria, 94% yielded varieties of Aerobacter as the principal slime producers; 6% of the cultures isolated were more closely related to the genus Escherichia than to the genus Aerobacter." Of this group, Aerobacter Aerogenes was the principal organism in 35% of these samples and Aerobacter Cloace in 59%. Since both are Gram negative, non-spore forming bacilli, fermenting lactose with gas formation, they are of sanitary significance under present standards.

Shannon and Wallace[6] isolated some 495 speci of bacteria from dead ends and localities producing complaints of sickness thought to be water borne. Of these, 32.5% were members of the coliform group; 58% were other Gram negative rods; 8.5% Gram positive coccus; and 1% Gram positive rods. This study extended over a period of 4 years. A residual chlorine concentration of 0.15 to 0.25 ppm. was maintained in the plant effluent for about half the period and of 0.27 to 0.35 ppm. as chloramines for the remainder. The data presented indicate that chloramines, contrary to expectation, do not control slime producing organisms in the "dead ends."

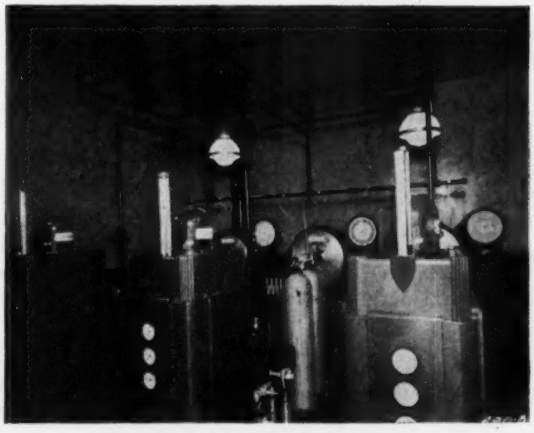
Howard[2] reports coliform organisms in excess of 1 per 100 cc. in the Toronto distribution system between June and December over a five-year period. The raw water was super-chlorinated and the plant effluent carried a residual of 0.08 ppm. entering the distribution system. In this report, it is assumed that chloramine treatment would successfully prevent bacterial decomposition in the distribution system. Also since "there is no indication of gastro-enteritis during

Typical chlorination station.



the troublesome period involved in many cities, it can be stated with a definite degree of assurance that such growth in the distribution system does not constitute a health hazard and are of little sanitary significance" when adequate initial sterilization is employed and no secondary contamination occurs.

In July 1896, the Baltimore City Health Department began routine bacteriological examination of samples collected at irregular intervals from stores and residences and tested for total counts and B.coli. The Water Department began routine sampling on May 5, 1925, from fire plugs and "dead ends." On December 7, 1926 sampling from taps in fire engine houses was established by both departments.[1] One sample per week is collected from taps and the five reservoirs as regular practice. Samples of the plant effluents are collected at six-hour periods each day. Reservoir samples are taken just below the surface at a point about 10 feet from shore by using a pole to which a carriage has been attached for carrying the sterile bottle. Procedures established by the "Standard Methods of Water Analysis, American Public Health Association, 8th edition"[7] are consistently followed using the confirmed B.coli test and Gram stain procedures. Samples are delivered to the laboratory uniced.



Chlorinators and controls.

The coliform density as MPN of the water delivered to the distribution system is consistently low as shown in the following table:

19-Year Average Samples Collected Every 6 Hours

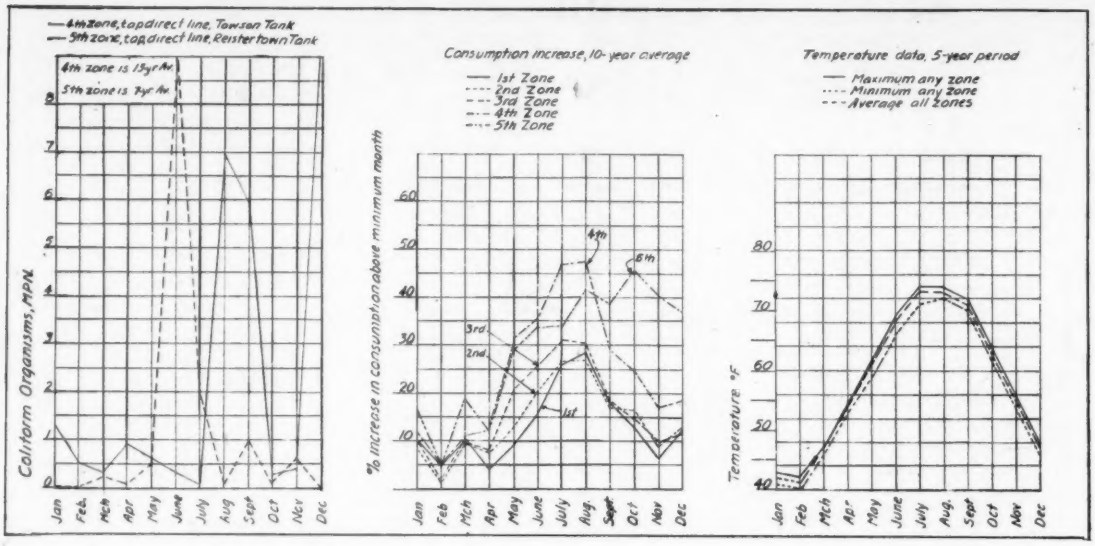
Jan.	0.05	May	0.06	Sept.	0.20
Feb.	0.05	June	0.10	Oct.	0.15
March	0.05	July	0.19	Nov.	0.13
April	0.03	Aug.	0.10	Dec.	0.04

A density of 1.38 MPN was reported in June, 1931, but 0.1 has not been exceeded since 1940. Coliform organisms were absent during 1944 and 1945.

A study of the various curves showing the conditions of the water in the distribution system indicates that with adequate sterilization prior to entering the system, serious secondary degradation does not occur. Conditions in the closed system of the 1st Zone served directly from the filtration plant clear well, disclosed sporadic increases in coliform organisms. Samples taken from the Dundalk Engine Station at the far end of this system are in reasonable bacterial agreement with those taken from the stations fed directly from the clear well. Had these data been presented in voluminous tables, this fact would be easily noted. The tap on the direct line from the filter plant has continuously given zero coliforms since October 1941 and only sporadic densities prior to that time. The distant sample has also shown similar conditions.

Water from Druid Lake balancing the Montebello clear well in the 1st Zone showed the occasional presence of coliform organisms. The density of these organisms was similar to those in the closed portion of this Zone, showing the value of secondary chlorination either by manual or automatic operation. Conditions at the No. 58 Engine Station some eight miles distant from the lake, and at the end of the system, are comparable with the other stations in this Zone with most samples showing absence of the coliforms. The July peak is caused by very high concentrations (25 MPN) in 1936 and again (49 MPN) in 1937.

Samples taken from the No. 31 Engine Station, served directly by Guilford Reservoir, and from the No. 8 Engine Station, similarly served from the Ashburton Reservoir, are in agreement with conditions in the 1st Zone, particularly after installation of the automatic chlorinators. Samples from the distant points of this Zone, Engine Station No. 42 and Halethorpe



Engine Station, showed conditions comparable to the distant points in the 1st Zone, with the peaks due to isolated high coliform densities. The Halethorpe Engine Station is about twelve miles distant from the Ashburton Reservoir and the line passes through much sparsely inhabited territory. For this reason, temperatures taken at this station were 4°F. higher than from any other station in this system. It is significant that the bacterial content at this station did not consistently increase with temperature increase but showed the characteristic sporadic conditions of the other stations.

In the 3rd Zone supplied by the Towson Reservoir, it is significant that the No. 56 Engine Station, within two miles of the reservoir, reflects conditions similar to the other zones; and since the installation of the automatic chlorinating stations, it has shown only sporadic occurrences of the coliform group. The high density in June and July occurred in 1939-40 in the direct line tap which was reflected in the distant area in 1939 but not in 1940. The Pikesville Engine Station, within 2 miles of that reservoir, had two instances of high density in 1936 and 1939 which were also reflected in the distant area tap. This is coincidental since the densities are higher in the distant station in 1939 and the reverse is true in 1936. Coliform organisms have since been constantly absent at both stations.

In the #4 and #5 Zones supplied directly from elevated tanks, the peaks reflect only sporadic increase in organisms in each instance of high magnitude for a particular year.

As shown in the accompanying curves, there is practically no difference in water temperatures through the various zones. All followed the same magnitude in relation to seasonal changes, and the changes were not followed by an increase in coliform organisms. Therefore, it is obvious that the increase in temperature during the summer season does not produce increased bacterial degradation in the system.

Increase in flow velocities through the system during normal summer consumption were originally thought to be of importance since it was believed that these conditions would disturb the slime coating on the pipes, thereby explaining the sporadic increases of coliform concentrations during the period of heavy use. This is not borne out, since again, concentrations of bacteria do not follow the trends of velocities in the system during these periods.

Investigation of a majority of the sporadic outbreaks disclosed that main repair or construction work of magnitude was being accomplished in the localized area at the time the sample was taken. This has been supported by a careful review of the departmental

(Continued on page 28)

Supplementary Data on MPN of Coliform Organisms, 1941-1945

The data below are based on monthly averages for the 5-year period, and can be used to prepare 5-year charts for all zones.

1st Zone: Direct line from Filter: 1941, Oct. 0.5; all other months 0.0; Tap distant from Filter: 1942, Nov. 0.5; 1944, June 2.4; all others 0.0; direct line from Druid Lake: 1941, Dec. 3.0; 1943, Aug. 0.4; all others 0.0; Tap distant from Druid Lake: 1941, June 1.0, Dec. 4.0; 1942, Mar. 1.6, Nov. 0.4; 1943, June 0.4. All others 0.0.

2nd Zone: Direct line from Guilford Reservoir: 1941, May 0.9, Oct. 46.0; 1942, July 1.0, Aug. 0.5, Sept. 0.5; all others 0.0. Tap distant from Guilford Reservoir: 1941, Apr. 14.0, May 3.5, June 1.3, July 47.6, Oct. 0.5; all others 0.0. Direct line from Lake Ashburton: 1941, June 0.2, July 0.4; 1944, Sept. 0.5; all others 0.0. Tap distant from Lake Ashburton: 1941, July 0.4, Aug. 15.0, Sept. 3.2, Dec. 0.4; 1942, May 1.0, June 0.8, July 59.0; 1943, Apr. 0.5, May 10.0, June 1.0, July 0.5, Aug. 0.8, Nov. 57.6, Dec. 0.5; 1944, May 48.0, June 10.3, Aug. 2.3, Sept. 10.8, Oct. 0.8; 1945, July 0.4, Aug. 0.5; all others 0.0.

3rd Zone: Direct line from Towson Reservoir: 1941, Jan. 1.3, Apr. 3.0, May 0.5, June 1.3; 1942, June 0.4; 1944, June 0.4; all others 0.0; tap distant from Towson Reservoir: 1941, Jan. 8.8, Apr. 0.4, May 0.5, June 1.3, Aug. 5.0, Oct. 1.5, Nov. 1.3; 1942, June 1.0, July 0.8, Sept. 0.4; 1943, July 0.5; 1944, Jan. 0.5, Aug. 0.5; all others 0.0. Direct line from Pikesville Reservoir: 1941, July 1.1, Aug. 1.1; 1942, Oct. 0.4; all others, 0.0; tap distant from Pikesville Reservoir: 1941, July 0.4, Aug. 0.5; Dec. 0.4; 1944, Sept. 62.3; all others 0.0.

4th Zone: Tap on direct line from Towson tank: Of the 60 months, 51 months were 0.0; the remaining 9 months showed MPN ranging from 0.4 to 70.0.

5th Zone: Tap on direct line from Reistertown tank: MPN for 46 months, 0.0; the remaining 14 months showed MPN 0.4 to 60.0.

Plants: MPN of coliform organisms delivered to the distribution system by the two plants for the 5 years, 1941-46, never exceeded 0.16 for any month; 86% of the 120 reports covering the two plants for 5 years showed 0.0; and all reports for 1944 and 1945 were 0.0.

Results of Experiments to Improve Asphalt Subsealing Methods

Rate of cooling of asphalt, distance of travel under pavement slabs, magnitude of lift, and slab deflection before and after injection of asphalt are reported.

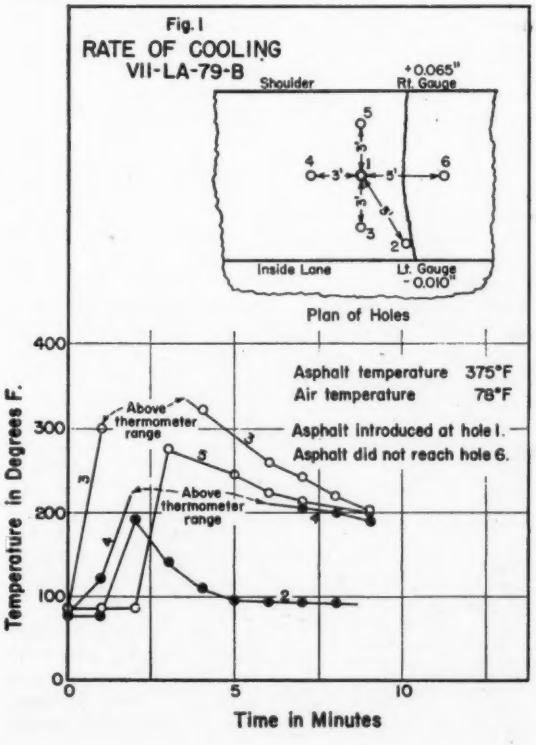
By H. L. Cooper, Assistant Maintenance Engineer, and W. R. Lovering, Assistant Physical Testing Engineer, California Division of Highways.

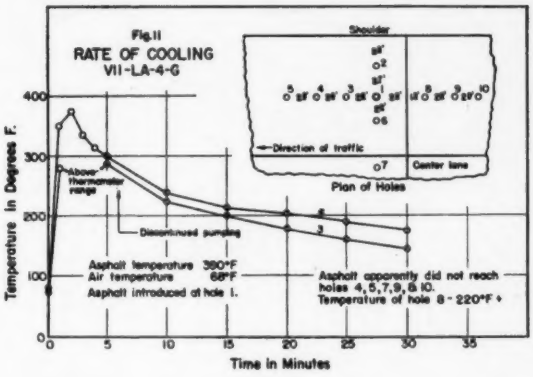
OBSERVATIONS and experiments made during the summer of 1946 by the California Division of Highways have disclosed new data on asphalt subsealing of concrete highways to reduce slab movement, eliminate pumping conditions, and seal the pavement from the bottom side. Data on this work were reported in California Highways and Public Works, along with information on costs. In District X, holes required an average of 8.0 gallons of asphalt each and cost $2.15 per hole. In other Districts, costs varied, mainly with the equipment used, up to $4 per hole and as much as 12 gallons of asphalt were used per hole on some projects.

Experimental Work

Measurements of the temperature of asphalt after injection beneath the pavement and the movement of the concrete slabs, both during subsealing and under loaded trucks, were made to secure information on the following.

1. The rate of cooling of the injected asphalt (which will affect the distance of travel or flow beneath the slab.)
2. The deflection of broken and unbroken slabs under heavily loaded trucks.





3. The magnitude of lift given each slab by the asphalt.
4. The distance to which the asphalt can be forced beneath the pavement.
5. The deflection of slabs both before and after injecting the asphalt.

The measurements of lift and deflection of the slab were made with an Ames dial registering to .001 inch. The Ames dial must be protected from contamination with dust or oil and a case was made that could be dismantled for cleaning. This eliminated the possibility of a sudden blow-out of asphalt making the dial unfit for further use.

Rate of Cooling of the Asphalt. Holes were drilled in the concrete at various distances from the point of injection. Short sections of three-eighth-inch pipe were set in jackhammer holes with plaster-of-paris. A small cork was then used to hold Weston or dial type thermometers in place in the pipe. Temperatures were recorded at one minute intervals during injection of asphalt and at longer intervals as the asphalt cooled, as shown in Figures I and II.

As shown by the graphs, the rate of cooling varies greatly with the thickness of the asphalt layer. It appears from these measurements that in many cases at least one hour is required for the asphalt to cool to normal subgrade temperature.

A comparison of the observed temperatures for Hole 2 and Hole 3, as shown in Figure I, shows a longer cooling period was registered at Hole 3. This was apparently caused by a thicker layer of asphalt and leads to the conclusion that there was a larger cavity at this point.

Temperature measurements were not made under slabs where free water was present. A more rapid chilling of the asphalt would be expected under these conditions. As the asphalt was pumped under the slabs, water was forced out at the cracks, but as the pumping continued this same water was sucked back under the

pavement. This leads to the conclusion that when free water is present the asphalt is chilled in a relatively limited area around the point of injection, causing the slab to be raised on a localized support which creates a partial vacuum at the unsupported corners.

Deflection of Slabs Under Heavily Loaded Trucks. At several locations measurements were made of the movement of slab ends under loaded transport trucks. These measurements are not directly comparable as the weight of the vehicles was not constant, but do give an indication of the normal movement of the slabs under typical commercial loads. A deflection of 0.015 inch was measured on a 20-foot slab under a loaded two-ton truck, and a deflection of 0.025 inch was measured on an unbroken slab under a loaded freighter.

On U. S. 50, in the vicinity of Mossdale, there was definite evidence of rocking slabs. A few measurements were made where the end of a 25-foot slab raised from 0.003 inch to 0.005 inch as the loaded truck wheels came in contact with the opposite end. The end of a broken slab moved upward 0.20 inch and downward 0.015 inch registering several complete cycles above and below the normal elevation as the various wheels of a loaded freighter passed over.

An interesting series of deflection measurements were made between Vallejo and the Napa Wye, on U. S. 40, on pavement constructed in 1944. Measurements made at 7.00 a.m. on July 16, 1946 showed that one end of the slab was moved approximately .003 inch upward as the front wheels of loaded trucks came onto the opposite end of the slab. As the truck progressed along the slab and the rear wheels came on the end being measured a downward movement

DEFLECTION OF SLABS BEFORE AND AFTER SUBSEALING
II-SHA-3-B

Slab † No.	Deflection Before Subsealing — Loaded Truck * Front Wheel	Rear Wheel	Amount of Slab lift produced by Asphalt	Deflection After Subsealing — Loaded Truck Front Wheel	Rear Wheel
1	.016"	.039"	.233"	.000"	.015"
2	.080"	.090"	.110"	.009"	.016"
3	.015"	.027"	.126"	.009"	.019"
4	.050"	.064"	.010"	.009"	.019"
5	.015"	.030"	.077"	.002"	.009"
6	.005"	.023"	.243"	.001"	.008"
7	.014"	.027"	.220"	.004"	.011"
8	.029"	.047"	.330"	.003"	.012"
9	.011"	.038"	Adjacent Slab Raised	.006"	.016"

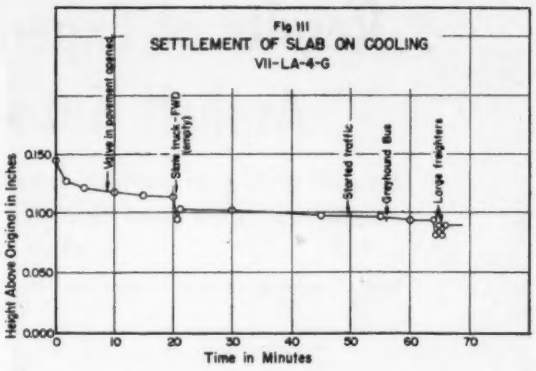
* Total gross load of truck 20,600 pounds.
† Numbers arbitrarily assigned for these measurements only.

of approximately 0.025 inch was noted. These measurements confirm profilograph records and indicate that the 15-foot slabs were curled upward and were rocking on the subgrade. Measurements made on these same slabs between 12.30 p.m. and 2.00 p.m., on the same day, after the heat of the sun had expanded the surface of the slab, showed no upward movement and a downward deflection under loaded trucks of only 0.004 inch.

The Magnitude of Lift Given Each Slab by the Asphalt. In the first subsealing work no attempt was made to raise the slab, the object being to force only sufficient asphalt under the slab to fill cavities and in addition provide a membrane that would seal off the subgrade and prevent further loss of subgrade material through the cracks in the concrete pavement.

Slabs should in all cases be given a lift of from 0.05 inch to 0.1 inch to assure that contraction of the asphalt on cooling will not leave the slab unsupported. A typical example of slab settlement is shown in Figure III.

It is not possible by this method to raise slabs which are completely in contact with the subgrade. With the 40 pounds per square inch pressure normally used, it is necessary for the asphalt to spread over



an area of approximately three square feet before sufficient hydraulic pressure is exerted to lift a 20- by 11-foot slab.

Distance to Which the Asphalt Can be Forced Beneath Pavement. Temperature measurements and observation of asphalt pumping operations indicate that the asphalt can be forced into any cavity which may exist beneath the pavement. Several cases were noted in which the asphalt forced its way beneath the adjacent bituminous shoulder and came to the surface 12 feet from the point of injection. As noted above, the spread of the asphalt may be restricted by the presence of free water beneath the pavement slab. Additional temperature measurements should be made for a complete study of results obtained where free water is present. The distance to which the asphalt can be forced is determined by the temperature of the asphalt at injection and the size of the void beneath the pavement.

The most satisfactory asphalt injection temperature seems to be from 375 degrees to 425 degrees Fahrenheit.

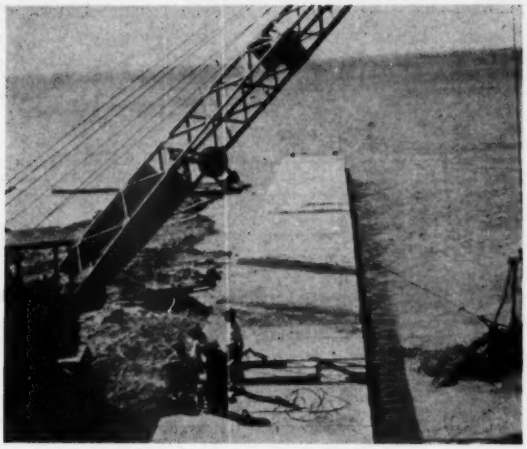
Deflection of Slabs Before and After Injecting Asphalt. Deflection measurements under a loaded truck were made on slabs before subsealing with asphalt and again after sealing using an identical load. The second measurements were made the next morning after an elapsed time of 24 hours and showed an average reduction in slab deflection of 60 per cent. See Table I.

Extrusions of Asphalt. During 1944 and 1945 asphalt having a penetration of 40-50 and 30-40 was used. It was found that some extrusions took place due to the fact the asphalt apparently was too soft. This year asphalt of 20-30 penetration was used in all subsealing work. However, especially where air temperatures are high, small extrusions still take place where the drill holes have not been filled with cement grout or with wooden plugs. Possibly a slightly lower penetration asphalt should be used in the future for this type of work.

Conclusions

1. The asphalt, after being injected, will cool to subgrade temperature in from 15 minutes to one hour, depending on the thickness of the asphalt layer.
2. Free water under the pavement may chill the asphalt too quickly to permit satisfactory distribution.
3. The asphalt may be forced into any void beneath the pavement except when free water is present.
4. A lift of 0.05 inch to 0.10 inch should be given to all slabs and lifts up to one-half inch may be given if slabs are low.
5. The deflection of slabs under loads are materially reduced by asphalt subsealing.

The pier under construction.



The completed pier before cleaning up.

Illinois City Constructs Combination Pier and Sewer

A permeable pier of precast concrete sections on precast concrete piles cradles a 54" storm sewer which discharges at the end of the pier.

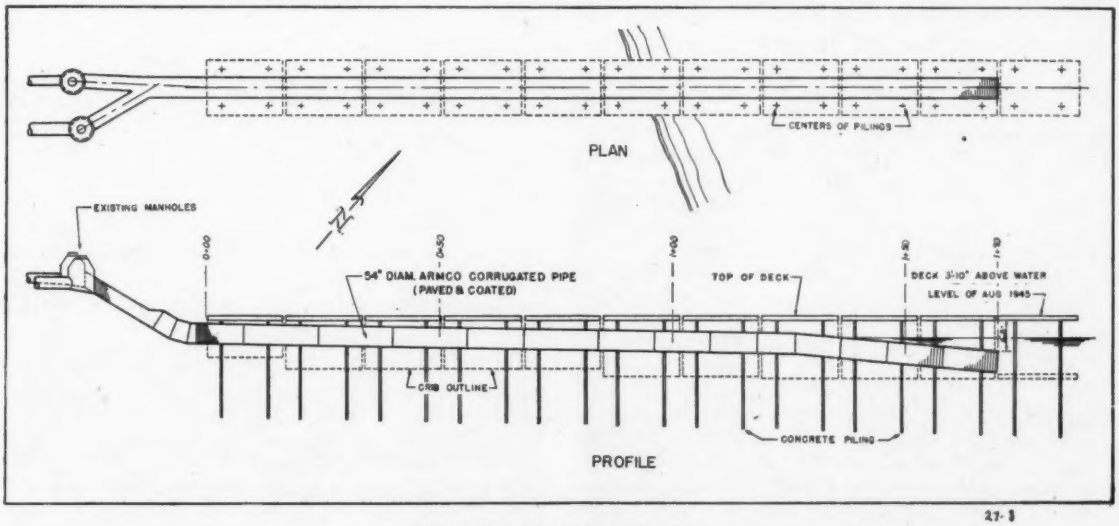
By ROBERT L. ANDERSON
Village Engineer, Winnetka, Ill.

THE Village of Winnetka, Illinois, a suburb of Chicago, recently installed an outfall storm sewer in connection with a concrete permeable pier. This construction is along the western shore of Lake Michigan and the storm water from the outfall discharges approximately 150 feet out into the lake.

The installation actually serves three purposes. The pier, of special design, acts as shore protection by causing the deposit of sand along the shore and by reducing wave action; it is a recreational facility for sun-bathers using the sandy beach; the cross section is designed to cradle a 54" Armco paved and coated pipe which discharges underwater at the lake end of the pier.

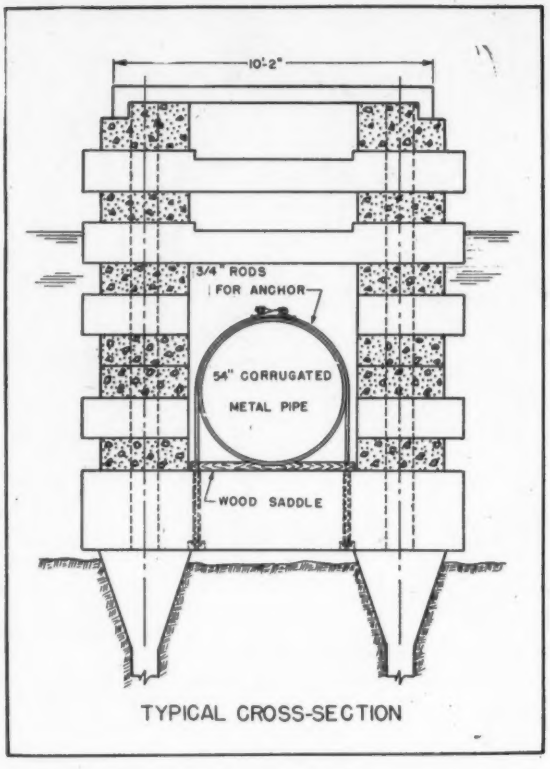
The pier was built on park property by the Winnetka Park District while the sewer installation was a responsibility of the Village. The combining of the two into a single construction project necessitated close cooperation in planning.

The specially designed concrete permeable pier consists of an open grille work of precast concrete sections set on precast concrete piles. The piles vary from 22 feet to 36 feet in length according to the loads involved and the water depths. The concrete pier sections are constructed with collars at each end which slip over the piles, after which they are grouted in place. Projections on the longitudinal pier sections are varied to achieve the desired per cent of permeability in the lattice along the length of the pier with practically no open area at the shore to about eighty per cent



27-3

Plan and profile of pier and sewer.



TYPICAL CROSS-SECTION

permeability at the lake end. The amount of open area also varies from the top to the bottom of the pier with more voids in the upper members.

Concrete deck slabs completely cover the top of the pier, hiding the sewer beneath. The cut above shows a cross section through the pier and the method of installing the sewer line. It is noted that the pipe is secured by means of U bolts and anchored to the saddle.

The pipe installation tends to minimize the desired action of the permeable nature of the pier. The open area is reduced somewhat, causing more sand to deposit on the windward side, the action being more pronounced at the shore end where the water is shallower. The engineers decided it was necessary to sacrifice a part of the efficiency of the pier, however, to obtain a solution for the outfall sewer problem.

Armco corrugated pipe was used for this installation since it could be placed in long lengths and could span between the cradle supports. It also provided positive water-tight joints which could resist the wave action in the lake without disjointing. It carries the water discharging from two 36-inch pipes into a "Y" connection at the lake shore. The writer was in charge of both design and construction of the sewer portion of the job. The pier was designed by Sydney M. Wood of Lake Bluff, Illinois, with Harry Thatcher of Waukegan, Illinois, as contractor.

The Control of Water Quality

(Continued from page 24)

records and the evidence is sufficiently characteristic to warrant the conclusion that the sporadic bacterial degradation observed over the period of years must be considered as being caused by excessive flow velocities in the large mains. These are due to flushing because of work, large fires and similar unusual local disturbance rather than by either temperature or normal velocity changes. These excessive flows dislodge the slimes existing on large pipe surfaces and, as previously shown by Sanborn, explain the localized increase in B.coli organisms.

Although residual chlorine determinations have been regularly made from each station each week, it is recognized that the readings obtained do not necessarily reflect the true picture of chlorine concentrations since only the total orthotolodine color is reported. With the information developed by the sodium-arsenite test and the subsequent use of the "flash" test, it will be possible in future testing to report only true chlorine residuals from the field. For this reason the chlorine figures obtained over the past years are not considered significant and no effort was made to reconcile them with bacterial conditions as reflected by the B.coli test.

Since the water entering the distribution system has been adequately treated and sterilized, it is obvious that all pathogenic organisms initially present in the raw water supply have been killed. With the secondary chlorination of the open service reservoirs, pathogens remaining in these sources have been destroyed. Therefore, it is apparent that the sanitary significance of the presence of coliform organisms in distribution systems properly safeguarded by initial sterilization of the plant effluent and of water from secondary reservoirs, is of little merit. This is supported by the fact that there has been no known outbreak of typhoid fever or serious gastro-enteritic disease in this city.

It must, therefore, be concluded that, exclusive of dead ends in very localized areas, there is no significant bacterial degradation in the distribution system when the water is adequately initially sterilized and when sufficient sterilization is maintained over secondary sources.

The information serving as the basis for this paper was obtained from the official records of the Bureau of Water Supply, Department of Public Works, Nathan L. Smith, Chief Engineer, through the courtesy of Leon Small, Water Engineer. Assistance given by Gordon L. O'Brien, K. H. Schamberger, B. L. Werner and C. A. Warren of the Bureau of Water Supply by furnishing information concerning incidents and specific operations of the system is appreciated.

References

1—Ewing, C. Leroy and Hopkins, Edw. S., J. Amer. Water Wks. Asso., 22, 1495 (1930).
2—Howard, Norman J., J. Amer. Water Wks. Asso., 32, No. 1 (1940) and Con. Eng. (Water and Sew.), 79, #11, 20, 41 (1941).
3—O'Brien, Gordon L., Water and Sew. Wks., 89, 271 (1939) and Water Wks. Eng., 94, 172 (1941).
4—"Public Health Service Drinking Water Standards," Pub. Health Reports, 61, 371 (1946).
5—Sanborn, J. R., J. Bac., 48, 211 (1944).
6—Shannon, Albert M. and Wallace, William M., J. Amer. Water Wks. Asso., 36, 1356 (1944).
7—"Standard Methods for the Examination of Water and Sewerage," 8th ed., Amer. Pub. Health Asso., N. Y. (1936).
8—Wilson, Carl, J. Amer. Water Wks. Asso., 37, 53 (1945).

Damages Paid for Killing Fish by Industrial Wastes

The Ohio Conservation and Natural Resources Commission started action against an industrial company of Toledo to recover damages for the killing of several hundred thousand fish by chromic acids and cyanides which it had dumped into Little Miami river. After the attorney general's office had prepared to file suit the company agreed to pay the state $18,000 and furnish 200,000 minnows for restocking the stream.

An Easy to Use On-the-Job Training Program for Your Highway Personnel

For text references, definitions and nomenclature, see page 17 of this issue.

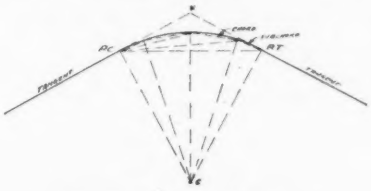
I—Preliminary Investigations; Surveys and Field Data

General.—The first consideration in planning a road is to know what the road is intended to be used for and what the limiting factors in respect to it are. For instance, should the road be designed for high-speed traffic, or low-speed; for heavy wheel loads, or light; and what are the limiting factors of cost and time of construction? In some cases, the equipment available for construction may impose limitations on the plan. Unless data on these, and often on other problems, are available, the preliminary steps of surveying, locating and estimating cannot be based on real needs. For this reason, it is helpful in training, or for the student, to make definite assumptions regarding the needs or purposes for which the road is intended, and the general standards of design that should be applied.

Factors in Location.—In either the location of new highways or the relocation of old ones, a careful study must be made: (1) To serve the largest possible number of people and develop to the greatest feasible extent all of the resources of the area through which it passes—agricultural, commercial and industrial; (2) to select a location with good natural drainage, where stable foundations are available, and avoiding areas subject to flooding or similar hazard; (3) to maintain grades within reasonable limits, avoiding excessive rise and fall; (4) to avoid sharp curves and dangerous railroad crossings; (5) and to avoid locations along stream beds, northern exposures in mountainous areas, and places subject to excessive snow drifting.

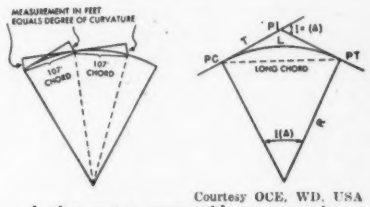
The first factor, the economics of the road location, may apply equally to a new road or to the improvement of certain of a net of existing roads, and may fix the general location. The specific physical location is determined only after preliminary reconnaissance and, usually, actual surveys. The purpose of a survey is to obtain precise data on field topographic conditions. Before making a survey, the location of the proposed road must be quite closely known, and this may require extensive preliminary work.

For a new road, in unknown territory, a reliable map will permit an approximate selection of the line to be followed. Aerial photographs may be used to supplement the map and are helpful in disclosing wooded areas and rugged terrain. The line selected from the map or aerial photographs should be checked by ground reconnaissance. Surveys may then be made, the approximate center line located, and the additional needed information listed above can be obtained.



Elements of a vertical curve.

Instruction Aids.—Maps with contours, as U.S. Geological Survey maps, and aerial photographs, preferably of the same area; scales, contour intervals and interpretation of symbols should be emphasized, as well as recognition of ground features on air photos. *References.*—Bruce, Chapters 2 and 3.



Courtesy OCE, WD, USA

Laying out a curve without a transit.

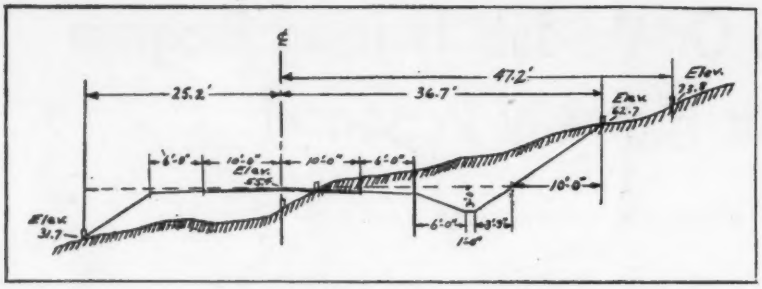
Courtesy Fairchild Aerial Surveys, Inc.

An air photo of a portion of a city.

II—Ground Surveys

The Transit Line.—A transit is used to measure the angles of the survey line and a metal tape to measure the distance. The survey line is marked by stakes, indicating a succession of straight lines. Some engineers prefer to keep the survey line offset from the probable final center line of the road so that traffic on an existing road, or construction on the proposed road, will not interfere with the survey line. In this case, the final center line is indicated by offsets, when it has been decided on. Other engineers prefer to have the transit line as nearly as possible on the final center line of the road. The starting point, in any case, should be referenced to permanent markers and is indicated as Sta. 0 + 00. Stakes are usually placed along the transit line 100 feet apart, at all important points, as intersections with other roads, and at changes in direction. At these points of change in direction, curves will later be laid out.

Even on existing roads, transit surveys will usually be necessary, since precise data are needed if any work is to be done that changes the grade or elevation, increases the width or modifies the curvature. In addition, whenever construction may encroach on private property, surveys must be run to determine the extent of encroachment and on whose land it is; and to prepare



A cross-section showing cut and fill.

a legal description of the land for its purchase or condemnation.

The transit survey will, as previously stated, show a succession of straight lines indicating the general course of the road. Where a deflection exists, and the line deviates in direction from the preceding line, a curve must be inserted to connect the tangents or straight lines. Generally vertical curves are used, though other curves are sometimes employed. The curves are staked out in the field to indicate the exact course of the road.

Levels and Cross-Sections. — After the center line has been established, levels are run to establish the grade of the surface and to provide a basis for determining the cuts or fills that are necessary to meet the requirements of grade or alinement. Elevations are taken at each 100 ft. and at intermediate points where there is a marked change in slope, or where any other factor exists that may affect the finished grade. Also, cross-sections are taken along the entire road to determine the ground elevations on either side of the center line and at right angles to it. The spacing of these cross-sectional measurements and the distance they are extended from the center line depend largely on the terrain, but they should generally be made at 50-ft. or 100-ft. intervals and should generally cover at least 50 ft. on either side of the center line.

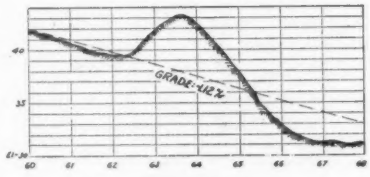
After the levels have been run and the profile of the ground established, the profile is plotted on drawing paper using a vertical scale that is about ten times as great as the horizontal scale, as 5 ft. to the inch vertical and 50 ft. to the inch horizontal. The profile of the road, as designed, is then drawn in. In rough country, this may be based primarily on the allowable grades; but in any case, it will indicate the depth of cut or fill, if any, at each station. Where grades intersect, as an ascending and a descending grade, or where there is a change in gradient, a vertical curve is inserted to avoid the sudden bumps that would otherwise result. The curve commonly used is a parabola.

Line and grade stakes are usually placed so that they will not be disturbed by construction operations. These stakes provide a reference for construction control. They may be placed on one or both sides of the roadway area, and should be sturdy and firmly placed; usually 50 ft. apart on tangents and 25 ft. apart on curves. Station numbers should be clearly marked on one side: on another side is shown the offset distance to the center line; and on a third side is shown the amount of cut or fill of the center line grade. Slope stakes may also be set, and are especially needed where there is heavy grading. These are placed at the toe of fills and at the top of slope of cuts. In some cases a grade stake is set at that point in the road cross-section where the ground surface is at grade.

Instruction Aids: Treatment of material in this section depends on prior training and experience of the students in surveys, and in the use of transits and levels. Procedure in laying out a curve, using a transit, may be demonstrated, if applicable to the students. Explain legal description of property and procedures for locating corners and making property line surveys. Explain profiles and cross-sections. *Reference:* Bruce, Chap. 2; Taylor, Elementary Surveying, Int. Textbook Co., Scranton, Pa.

III—Estimating Amounts of Excavation

General.—In order to estimate the cost of construction and plan properly for carrying out the work, it is necessary to know: The amount of dirt that must be taken from cuts; the amount that must be placed in fills, the average length of haul of this dirt, since the material taken from cuts is usually placed in fill areas; the amount of borrow material needed, and its location in case the cut material is insufficient



Fixing a grade.

or the hauls too long; and the amount of rock excavation. Other information is also necessary, such as soil types, and rainfall and stream flow data. This section will emphasize the methods of estimating quantities in cuts and fills.

Side Slopes.—The amount of material that must be taken from cuts and the amount required for fills and embankments will vary with the permissible side slopes; and these, in turn, depend largely upon soil types. The proper slope for any given soil and height of embankment can be determined by soil mechanics, but the process is difficult. The Highway Research Board recommends the following: Slope 1½ horizontal to 1 vertical, all sand fills and fills of cohesive soils not subject to inundation; slope 2 to 1, fills of cohesive soils more than 5 but less than 50 ft. high and not subject to inundation; slope 3 to 1, all fills of cohesive soils subject to total or partial inundation which are not over 50 ft. high. Fills more than 50 ft. high should be designed on the basis of soil mechanics. Embankments containing a high percentage of rock may be steeper than soils which do not contain a preponderancy of rock. In cuts, soil slopes should not exceed the angle of repose of the soil, which is normally about 1½ to 1, or 37° for sand and loam and about 1 to 1, or 45° for loose rock. The best slope to use is that which has proved to be satisfactory elsewhere in the vicinity where soil characteristics are the same.

Naturally the amount of dirt that must be taken out of a cut or placed in a fill is greater when flatter slopes are used. However, if side slopes are too steep in the original construction, maintenance costs will be correspondingly greater.

Cross-Sections.—From the profile of the center line of the road, the original ground surface, and the cross-sectional elevations, the amount of earth that must be removed from cuts or placed in fills can be computed. This may be done by the average end area method or the prismoidal formula. In either case, the ends of the sections are drawn to scale and the area measured by a planimeter or by counting the squares on a sheet of transparent cross-section paper. The sections are measured every 100 ft. in uniform ground, and elsewhere as necessary to give a true picture of conditions. The average end area method is simplest and is generally used. Tables are available in many highway handbooks, which show volumes for 100-ft. sections.

Other Factors.—The plans should indicate where rock exists, and separate computations are generally made to indicate the amount of rock excavation, though sometimes everything is grouped under "unclassified" excavation. Borrow excavation must also be computed. Allowance must be made for the change in volume of excavated material from the original volume in the natural deposit to the final compacted volume in the fill. Loose earth is from 14% to 50% more bulky than natural bank

earth, but as compacted in the fill it may occupy from 5% to 20% less space than it did before excavation. Hard rock, when blasted out may occupy considerably more space, since it may have 40% to 50% voids. In such cases, one cubic yard of solid rock may furnish from 1.6 to 2 cu. yds. of fill.

Instruction Aids. — Explain side slopes and angle of repose; from a profile with cross-sectional elevations, show how end areas are measured and utilize standard tables to determine volumes; demonstrate planimeter. *References:* Bruce, Chap. 2; HRB, Wartime Road Problems, No. 11; Taylor, Chap. 16.

IV—Design and Location

Traffic Requirements.—The volume of traffic will determine the number of traffic lanes. Theoretically a 2-lane road should handle about 2,000 vehicles per hour, a 3-lane road about 40% more, and a 4-lane road about twice as many. Although such traffic volumes have been recorded, the uncongested capacity is less, and may be assumed as 1,000 vehicles per hour for a 2-lane road, 2,000 for a 3-lane, and 3,000 for a 4-lane.

The speed of traffic influences many elements of design, such as curvature and sight distance. More important still may be the weight of traffic and the resultant loading applied to the pavement by the vehicle wheels. These factors of weight will be considered in another issue. In this section, consideration will be given to such physical features as grade, curvature, sight distance, width and superelevation. The recommendations made herein are generally applicable to primary roads but may be modified to agree with local standards and conditions.

Grade.—According to Bruce, grades on main highways should not exceed 5% in rolling country and 7% in rough country; the length of the grade also influences the permissible steepness. On short sections, even a 9% grade may be used; for sections over 500 ft. long, the grade should not exceed 6%, if possible. On secondary roads, somewhat steeper grades are permissible, but may not be necessary because of the usually greater flexibility of location. On primary roads, compensation for curvature on grades over about 5% is customary.

Curvature. — On primary roads, curvature should not exceed about 6°, which represents a radius of about 950 ft. A common standard is 1,000 ft. for primary roads and 500 ft. for less important roads. Location of the curve is important; a sharp curve at the end of a long straight section may constitute a much greater hazard than a curve of equal radius placed among other curves.

Sight Distance.—Closely allied to curvature is sight distance, or the length of road visible to the driver. The requirements are generally the same as for curves: About 1,000 ft. for primary roads and 500 ft. for well-traveled secondary roads. Consideration must also be given to sight distances on vertical curves.

No shoulders—now obsolete and dangerous.

Width.—Both surface or pavement width and shoulder width must be considered. Where expected traffic volume

A vertical curve between grades.

is over 500 vehicles per day, lanes should be 11 or 12 ft. wide, making a total surface width of 22 to 24 ft. For secondary roads carrying less traffic, the total width may be 20 ft. Pavements should be widened on curves having radii less than 1,000 ft. Shoulders should be 10 ft. wide on primary roads, giving a total road width of 42 to 44 ft. and on secondary roads, 6 to 8 ft., giving a total width of 32 to 36 ft.

Superelevation.—On roads carrying fast traffic, curves are normally superelevated. Experience has indicated that superelevation should be limited to 1¼ to 1½ inches per foot of width of the pavement in order to facilitate normal use. Using 1½ in. per ft., a speed of 60 mph. is permissible on curves up to about 850 ft. radius or a little more than 6½°.

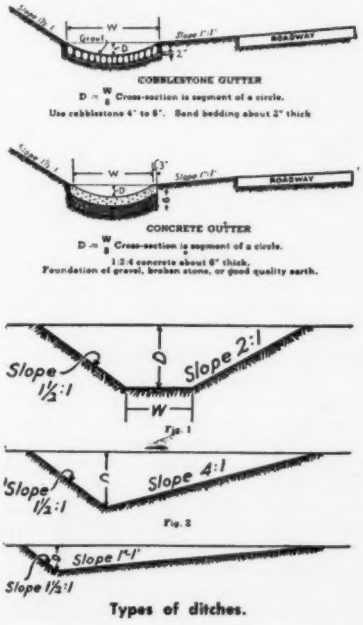
Instruction Aids:—Data showing variation of traffic by hours and days; data on wheel loads allowed by the State Highway Department; a chart showing local design factors for grades, curvature, sight distance, width, etc. *References:* Bruce, Chap. 3.

V—Surface Drainage

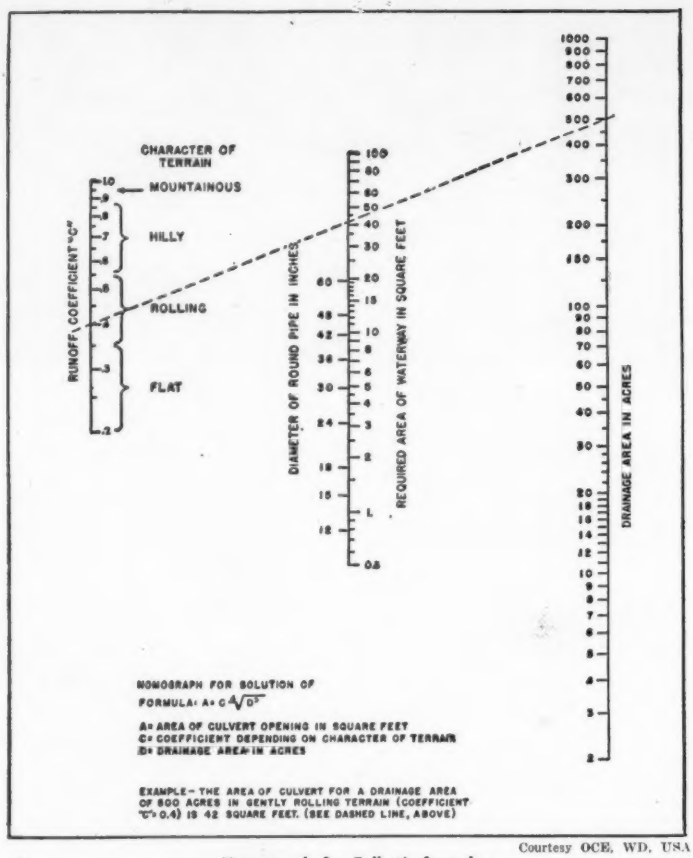
General.—There are three general phases of drainage: (1) Removing water from the road surface; (2) The movement away from the road of this and other surface water; and (3) the control of ground water by means of subsurface or other drains.

Road Surface Drainage.—It is necessary to remove water promptly from the surface of the road so that it will not interfere with the use of the road, either by its presence, because it freezes into ice, or because it damages the road. To accomplish this, the road is crowned. The amount of crown depends mainly on the character of the road surface; a smooth surface requires less crown than a rough one. For well-built surfaces of concrete or bitumen, about ⅛ inch per foot for one-half the width of the road is required. An earth road may need a crown of as much as ½ inch per ft. Most roads are curved to form the crown, using either a parabola or an arc of a circle, but the so-called A-section is also used.

Surface Drainage.—The purpose of side ditches is (1) to carry away water due to rain or melting snow that flows off the road surface; and (2) to intercept water from adjacent areas and discharge it away from the road. To carry the water to the lower side of the road before a volume is collected sufficient to erode the ditch or shoulder or overflow of the road, cross drains are needed about every 500 ft. on slopes less than 3% and about every 300 ft. on steeper slopes. A wide and shallow ditch is preferable to a deep one, even though



Types of ditches.



Courtesy OCE, WD, USA

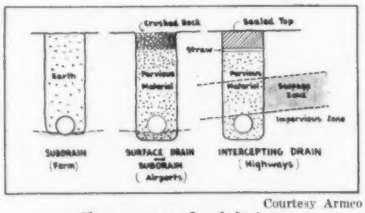
Nomograph for Talbot's formula.

the hydraulic qualities of the shallow ditch are not nearly so good; roadside ditches are not meant to be efficient hydraulic structures. Shallow ditches are more easily maintained and more easily susceptible to roadside improvement; and they are safer.

Slope and Velocity of Flow in Ditches.—Ditches should have slopes not less than 6 ins. in 100 ft. On level land, with cross drains 500 ft. apart, the ditch would be 2½ ft. deeper at the lower end; in such cases the ditch may slope both ways from a central point. The carrying capacity of ditches can be computed only approximately; observation of actual conditions during and after a storm is a good guide. In earth ditches, a velocity of more than 2 ft. per second is likely to cause erosion. Well grassed ditches will withstand a somewhat higher velocity, but when this exceeds 3 ft./sec., ditches should be lined, a pipe laid, or checks installed.

Linings and Checks.—Ditch linings may consist of field stone, concrete, or bituminous mixtures. When checks are used, it is preferable to have a larger number of small falls, from 9 to 12 ins. A 2% grade may usually be allowed between checks; with a 2% slope and a 4% road grade, checks would be 100 ft. apart. With grades greater than 5%, a lining or an enclosed pipe will usually be cheaper and better.

Culverts.—Culverts should have a minimum diameter of 18 ins. to reduce clogging. For larger culverts, the necessary opening depends on the area drained, the rate of rainfall, and the slope and character of the area. Talbot's formula is generally used for computing culvert openings. It is wise also to check on existing culverts or bridges on the same stream. Culvert alinement should coincide with that of the stream, with no abrupt changes of direction at either end, and the culvert should have the same general grade as the stream. Reasonable precautions should be taken to prevent the stream from changing its course in time of flood. Installation at the proper elevation, neither high nor low, is important. Culverts carrying main road ditches across side or farm roads may be set back from the ditch line and the road ditch offset accordingly.



Courtesy Armco

Three types of subdrains.

Headwalls and Inlets.—To protect embankments against scour and erosion, headwalls are constructed and riprap installed. Inlet structures should facilitate the entrance of the water into the culvert.

Instruction Aids. — Show typical crowned road surfaces, ditch slopes and ditch sections; demonstrate the Talbot formula for various conditions of topography and rainfall. Illustrate proper placement of culverts. *References.*— Bruce, Chap. 50; Armco, various publications; Highway Manual, Chap. 1.

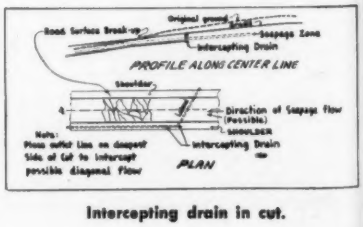
VI—Subdrainage

General.—Subdrainage is the control of ground water by means of underground drains which intercept seepage or lower the ground water level. The two kinds of subsurface water that affect highways are (1) capillary water; and (2) free water. Certain fine-grained soils will not only hold water in the soil pores, but may act as a wick does in a lamp to raise water from subsurface strata. Free water is the water table which exists under the ground surface and generally parallel to it, but at varying depths according to local conditions.

Field Examinations.—Before planning subdrainage, inspections and examinations should be made to determine actual conditions. In the case of existing roads, broken surface areas should be noted and surrounding conditions examined. It is preferable to make the survey during a wet period or as soon thereafter as possible. In addition to observation of seepage, springs and other visible evidence of the presence of ground water, investigations may be made to depths of 2 to 6 ft. using a soil auger. This may be done in connection with a soil survey (See Sect. IX). In general, the location and level of free water and the presence of soil which may contain capillary water should be determined; also the best location and proper depth for underdrains to lower the ground water sufficiently (1) to eliminate trouble from this cause; and (2) to prevent capillary water from rising to within danger distance of the subbase.

The problem is therefore one of controlling free water and there are two phases of this. One occurs in hilly or rolling areas where the ground water is in constant, though slow, movement from higher to lower levels, and incidentally passes under the road in its course. In this situation, the seepage zone is intercepted by a subdrain and

(Continued on page 62)



Intercepting drain in cut.

Allegheny County Sanitary Authority Progress and Plans

By JOHN F. LABOON
Chairman, Allegheny County Sanitary Authority

OF the 127 communities in Allegheny County, Pa., 102 have been ordered to cease discharging their sewage and industrial wastes into the streams of the commonwealth, and 77 of these are participating in the Sanitary Authority's program; 21 industries, out of 90 ordered, are doing likewise. The participants represent more than 85 percent of the total population of the area affected by the orders of the state. More will probably come in later, so that the work of the Sanitary Authority will be truly representative of a metropolitan plan of action.

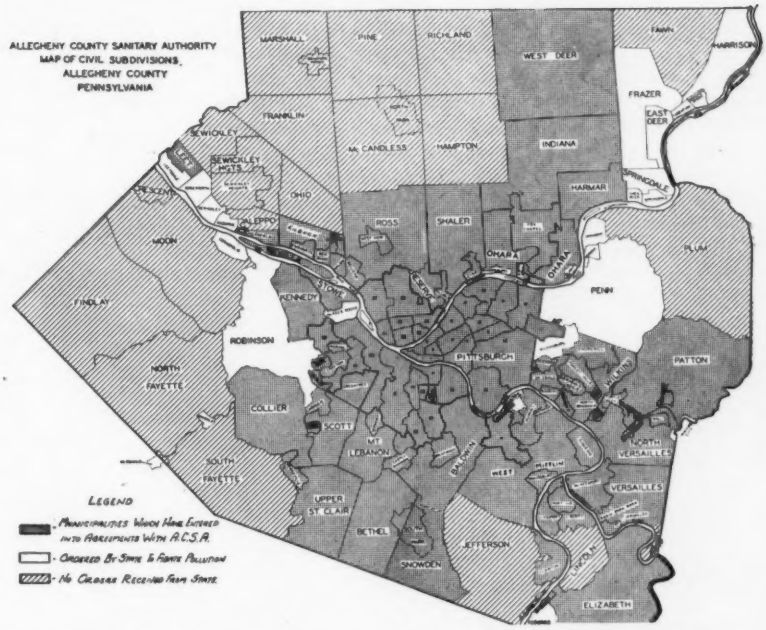
Charges for Extra Work

The deadline set for those who intend to participate was January 1, 1947. Municipalities who are on our list will be included in our program without charge, and participating industries have agreed to a nominal fee for the work entailed in checking their industrial wastes. Those municipalities who have been unable to make up their minds but who may desire participation at a later date, will be charged with the extra engineering work involved in refiguring our data, in redesigning our collecting system and treatment works to accommodate their wastes, and in revising the basic rate structure we intend to establish after our calculations have been made. Similarly, tardy industries will be additionally invoiced.

Since our inception last spring, we have been operating on funds advanced to us by the city of Pittsburgh, the State of Pennsylvania, and the Federal Works Agency of the government, and because of these loans and grants-in-aid we have been able to get under way. Participating communities are benefitting from this financial arrangement, but the agreements they have signed stipulate that they are to allocate to us any funds they may receive from state or government agencies for the purpose of preparing preliminary plans and surveys.

Complete Purification Possible

The rivers of our community, now open sewers, will be purified as soon as construction of a system of collecting sewers and a treatment works has been completed. While the state at present only demands a 35 percent treatment of sewage and industrial wastes, a higher degree of purification may be achieved through present plans which involve more than 100 miles of collecting sewers along the rivers. These will pick up the sewage now being discharged directly into the streams from the main sewer outlets, and divert it to a single treatment works, where the settleable solids and the scum will be removed and the cleaned water returned to the streams. If this is not possible, then a number of treatment works will be erected at various locations in the County.



The first phase of our work has been completed. This consisted of measuring the amount of sewage and the rate of flow in 33 main sewer outlets in the County. We found that the daily discharge of our sewage into the streams exceeds 200,000,000 gallons. Our engineers and chemists are now engaged in checking the industrial wastes originating from the more than 2,000 plants located in the County. Later on, they will concentrate on a phase of the work which has already been started: the compilation of water service data from 49 public and private water companies serving the district. Sewer rental charges will be computed from the amount of water used.

Ice Control for Airports

For icy airport runways, modifications of highway practices in treating and storing abrasives, and special precautions are desirable. First, it is very necessary that abrasives be treated with a minimum quantity of calcium chloride and stored in order that the alkalinity may adjust itself to or near the neutral zone. Freshly-prepared abrasives possess a pH of 8.5 to 9, but on exposure to air the pH quickly approaches the neutral point of 7 and remains near this point. Sand and cinders moistened with water retain a higher alkalinity than those treated with calcium chloride solution. Second, airport runways are readily accessible from one central stock point, thus eliminating the necessity of maintaining stocks of material at different points around the field. Treated abrasives should be protected from rain and snow by some roofing such as a special shed, closed bins or waterproof paper. The present general trend for airports and highways is to construct permanent storage in the form of bins or sheds, centrally located and of sufficient capacity to take care of the average winter requirements. — *Dowflake News.*

Chicago Installs New Safety Islands

Chicago plans to install new type safety islands as its present ones fall into disrepair. The new type islands are provided with a short concrete prow to deflect cars in case of collision and are equipped with yellow warning signals which are provided with constant illumination. Switches for these lights are controlled by an astronomical time switch which turns them on one-half hour before and off one-half hour after the street lights.

Public Works Engineering Methods and Data

A County Soil Cement Pavement

By FRANK J. HOLLAREN

Assistant County Engineer, Lyons Co., Iowa

A year ago Lyons County put in 2000 feet of soil cement pavement which had stood up very well under heavy traffic. This work was done by county employees using the following equipment: Caterpillar maintainer with scarifier; Seaman mixer; 750-gallon sprinkler; farm drag; sheepsfoot roller; pneumatic roller; 4-inch water pump; and our trucks.

The road was first scarified to a depth of 6 inches and then pulverized to a depth of 9 inches with the Seaman mixer. One bag of cement was used per lineal foot of 20-ft. road, or 0.45 bag per sq. yd. A farm drag was used to spread the cement and the mixing was then completed with the Seaman pulverizer; water was added while the mixer was kept working until the proper moisture content was reached. Then the sheepsfoot roller was started on the outside and worked until it "walked out." The road surface was then bladed to shape and the surface rolled with the pneumatic roller, following which it was covered with straw and kept wet for the curing period. A seal coat of oil and pea gravel was later put down. The work was supervised by E. B. Carson, engineer; the field tests and controls were by Mr. Clauson and Mr. Holdefer of the Highway Commission.

Rainfall and Runoff Data From Hartford

The Hartford, Conn., Water Bureau has collected rainfall and runoff data on its various watersheds for many years. The accompanying charts show rainfall, runoff and retention for the East Branch (area 61.2 sq. mi.) and Nepaug (area 31.85 sq. mi.) watersheds. There are eight rainfall and three runoff stations on the latter and seven rainfall and three runoff stations on the former. Data go back to 1913.

Nepaug Watershed.—The 1945 rainfall was 54.63 in.; average for 33 years, 45.11 in.; maximum, in 1937, 61.18 in.; minimum, in 1930, 34.89 in. Runoff in cubic feet per second per sq. mile of watershed area: 1945, 2.46; average for 33 years, 1.65; maximum, 2.48 in 1920; minimum, 0.85 in 1930.

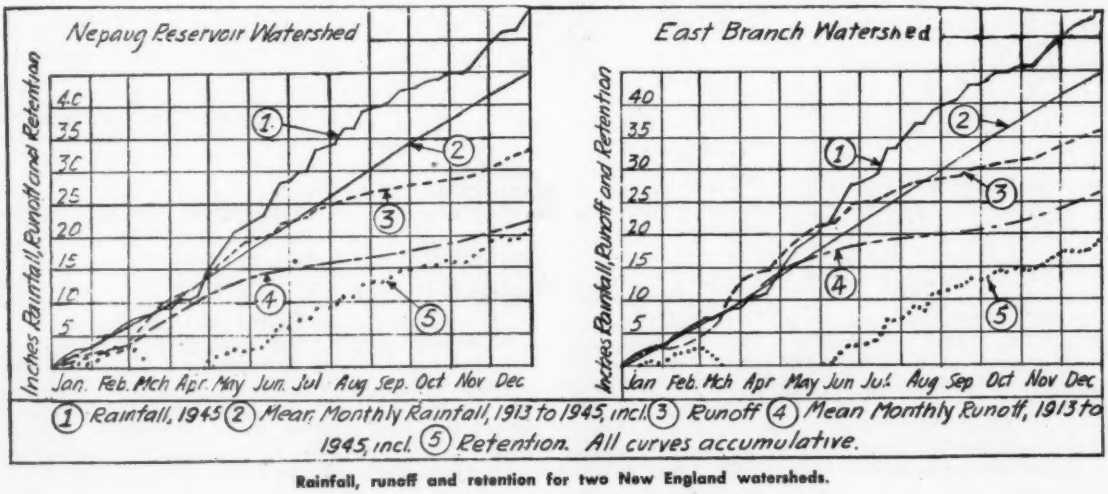
East Branch Watershed.—The 1945 rainfall was 55.16 in.; the average for 33 years was 44.47 in.; the maximum was 56.64 in. in 1938; the minimum, 33.11 in. in 1914. Runoff in cubic feet per second per sq. mile of watershed area in 1945 was 2.64; average for 33 years, 1.92; maximum, 3.26 in 1927; minimum 0.91 in 1941.

The accompanying charts show the accumulated rainfall by months for 1945; the accumulated mean monthly rainfall for the 33-year period, 1913 to 1945; the cumulative runoff for 1945; the accumulated mean monthly runoff for the 33-year period; and the retention, or difference between rainfall and runoff.

Operating Results at the Liberty Biofilter Plant

The sewage treatment plant at Liberty, N. Y., consists of primary settling tanks, 2 biofilters, a secondary settling tank and a magnetite filter for final treatment of the effluent. The supernatant overflow from the digester discharges into the inlet of the primary tank. The raw sewage samples, indicated in the accompanying table, are taken before the supernatant enters the channel and thus indicate the actual strength of the raw sewage. The primary influent consists of the raw sewage, the supernatant overflow, and a constant return flow of 1,400 gpm from the primary filter. The primary clarifier effluent indicates the result of primary settling.

The effluent from the primary filters is divided; 1,400 gpm are returned to the inlet of the primary sedimentation tank; the remainder, representing the volume of raw sewage entering the plant, is diluted with enough sewage from the secondary settling tank to make up to 2,100 gpm and is passed through the secondary filter. The effluent from this flows to the

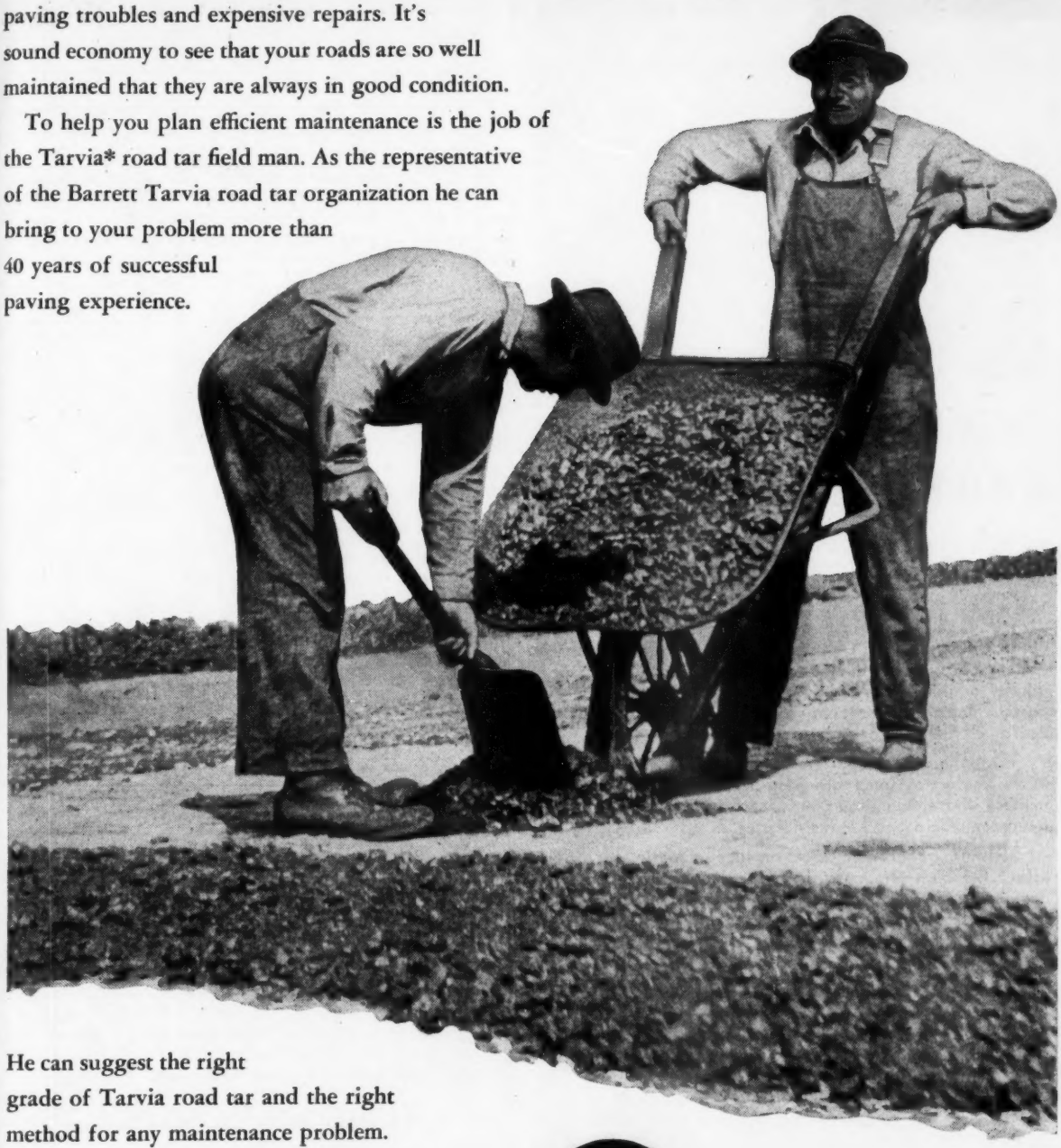


Rainfall, runoff and retention for two New England watersheds.

HOW TO KEEP A ROAD HEALTHY

Regular seasonal inspection and attention to small surface defects can often prevent serious paving troubles and expensive repairs. It's sound economy to see that your roads are so well maintained that they are always in good condition.

To help you plan efficient maintenance is the job of the Tarvia* road tar field man. As the representative of the Barrett Tarvia road tar organization he can bring to your problem more than 40 years of successful paving experience.



He can suggest the right grade of Tarvia road tar and the right method for any maintenance problem.

Why not check with him today? Plan *now* to put your roads in healthy condition . . . and to keep them that way.

• • •

"THE LONGEST MILE," a 30 minute, full-color, sound film on the development and importance of roads will soon be available for showing to highway officials, engineers and civic groups. Ask the Tarvia road tar field man for it, or write the nearest Barrett Tarvia road tar office.

Barrett

THE BARRETT DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

Tarvia*
*Reg. U. S. Pat. Off.

New York • Chicago • Birmingham • Detroit • Philadelphia • Boston • Rochester • Cleveland
Columbus • Youngstown • Ironton, O. • Syracuse • Buffalo • Cincinnati • Bethlehem • Portland, Me.
Bangor, Me. • Norwood, N.Y. • Oneonta, N.Y. • Elmira, N.Y. • Cromwell, Conn. • Norwich, Conn.
Savannah, Ga. • In Canada: THE BARRETT CO., LTD., Montreal • Toronto • Winnipeg • Vancouver

secondary clarifier. The effluent from this stage is passed through a magnetite filter before discharge.

One man, Harry Eichenauer, operates the plant, at times with one assistant. Due to the manpower shortage, infrequent samples were taken during 1945 and 1946, and these were composites from 8 A.M. to 1 P.M. The results are therefore considered to indicate a greater strength than would have been shown by 24-hr. composites, but are a good indication of the degree of treatment provided by the plant.

Summary of Operating Results at the Liberty Plant, 1945-1946

Date.	Flow MGD	Raw Sew.	Pri. Inf.	Pri. Clar Eff.	←Filters→ Pri. Eff.	Sec. Inf	Sec. Eff.	Sec. Clar Eff.	Final Eff.	DO Final
1945		BOD-Composite, 8AM to 1PM								
14 June	0.87	270	110	153	108	60	22	—	—	5.8
11 July	0.92	380	280	207	100	80	40	23	8	5.0
21 Aug.	1.05	320	220	196	120	90	44	20	5	4.2
31 Aug.	0.92	380	170	120	68	45	35	27	4	5.0
24 Sept.	0.90	380	280	147	57	49	30	21	3	5.6
22 Oct.	0.74	380	200	120	60	50	33	24	6	6.4
31 Oct.	0.73	300	180	120	73	48	—	24	14	5.0
Average 1946		344	206	151	83	60	34	23	6.7	
5 July	0.82	300	300	173	134	140	60	37	17	—
15 July	0.81	400	420	220	133	80	48	21	6	4.6
31 July	0.96	440	300	210	140	100	80	29	6	3.6
14 Aug.	1.05	360	480	220	140	145	49	32	10	3.8
23 Aug.	0.95	340	380	250	153	95	42	21	8	3.8
11 Sept.	0.77	360	300	193	120	80	45	28	6	5.8
Average		367	342	211	131	107	54	27	9	
1945	TS Raw	Suspended Solids								TS Final
14 June	547	160	240	96	70	78	48	28	10	264
11 July	814	252	220	96	92	66	54	25	5	302
21 Aug	691	240	252	96	110	86	62	26	5	302
31 Aug	622	312	196	84	82	32	28	16	5	301
24 Sept.	687	236	352	90	36	26	14	16	5	236
22 Oct.	698	212	216	88	58	34	30	20	6	260
31 Oct.	582	172	176	70	64	42	—	17	4	263
1946										
5 July	703	236	352	148	128	134	84	33	10	332
15 July	757	220	328	124	144	82	76	19	7	321
31 July	717	228	392	168	196	152	130	27	5	263
14 Aug	655	244	320	200	170	118	96	30	9	299
23 Aug	652	228	496	160	182	138	88	30	6	223
11 Sept.	662	232	436	202	132	82	66	23	6	359

There was no recirculation on the primary filter from 15 July to 11 Aug., 1945, due to the exceedingly wet weather during that period. Chlorination was discontinued on 23 Oct., 1945, which may account for the rather high final BOD of the test of 31 Oct.

The plant is operated as a biofilter during the summer months when the summer resort load is heavy, and as a straight trickling filter in the winter. For instance, recirculation was started on 24 May, 1945, and continued until about November.

15 Good Hints for Good Rolling

In describing a new, trailer type roller, which weighs 2000 pounds empty but can be weighted with either sand or water, *The Elbee Tatler*, house organ of Littleford Bros., Inc., under the above heading, says:

1. The use of different amounts of water or sand in the roller will give you compaction anywhere from 42 to 127 pounds per inch of roller width. Adjust the weight of the roller to suit rolling conditions.
2. Be sure that enough material has been placed in the patch.
3. Material must be raked very level before rolling, otherwise it will leave holes and give a rough appearance.

4. Do not roll hot mix materials when extremely hot. Let it cool until it will hold its compaction under the average operator's foot.

5. When rolling large patches, roll first for compaction—then roll to smooth out roller marks.

6. Roll the outside edges of the patch first. Always work up from the lower side of the patch.

7. Bituminous materials should be rolled with water to eliminate sticking to rollers. Keep roller moistened at all times, especially on sheet asphalt.

8. Do not stop the roller on the patch. The large roller will leave an imprint the full width of the roller.

9. Do not try to roll loose gravel, cinders, or any other dry material with more than 80-90 pounds compaction. Moistening before and while rolling will help stabilize the material so that greater compaction can be used.

10. Do not make sharp turns on patches. Wait until roller is on old or solid surfaces.

11. When rolling up close to curbs or buildings, tamp the edges that are hard to get to.

12. On a steep grade, best results are obtained by keeping the roller down grade.

13. Do not make too many passes over the material because it may crush the smaller stones and cause the material to become dusty.

14. When possible, roll the patch with the direction of traffic.

15. For good compaction, operate the roller as slow as possible.

Tokyo Water Supply Is Potable

A letter from Col. Jack J. Hinman, Jr., Corps of Engineers, who is with 8th Army Headquarters in Japan, contained a copy of Cir. 310, 27 Nov., 1946, which included the following:

1. The Tokyo City water supply when drawn directly from the city system and not supplemented by wells or booster pumps is declared potable. It may be consumed by military personnel without additional local individual or unit chlorination.

2. The area supplied with water from the Tokyo City water supply includes all of the area of Tokyo, except certain outlying portions of Setagaya-Ku, Suginami-Ku, Itabashi-Ku, Oji-Ku, Adachi-Ku, Katsushika-Ku, and Edogawa-Ku, which are not now furnished with water from the municipal pipe network.

3. In those sections of the city where booster pumps are required for individual buildings and residences or where private wells are inter-connected to the city supply, individual or unit chlorination will continue to be enforced as presently prescribed. Approval of the water supply on any premises where private wells or booster pumps are used will be on an individual basis. Applications for approval will be submitted to this headquarters describing the method of chlorination and the control measures to be exercised by the unit making application.

Mrs. Hinman is now with Jack, and they are living at the New Grand Hotel, Yokohama.

Pennsylvania Plans for Snow Removal and Ice Control

The Pennsylvania Department of Highways will maintain snow removal and ice control service on 20,341 miles of road this winter, an increase of 101 miles over last year. Much new equipment has been added. Two 42,000-pound trucks have been ordered, one of which has been delivered. These, equipped with large V-plows and wings will be used as a mobile reserve for augmenting equipment already assigned, when an especially hard storm strikes. More than 500 other new trucks have been delivered or are on order;

and 650 new snow plows, bringing the number available up to nearly 3,000, in addition to more than 250 motor graders which can be used. To augment facilities for heavy drift plowing, 10 new rotary snow plows have been ordered, bringing the number owned by the department to 32.

Refuse Collection and Disposal Costs in Rockford

Costs for refuse collection and disposal were recently reported by William H. Day, city engineer, Rockford, Ill., to the American Public Works Association for the 9 months, Jan. to Sept., 1946. The figures below include overhead charges, but no charge is shown for the site of the fill, since this is available to the city free. Disposal is by sanitary or land fill.

Costs of Collection.—Labor, $48,737; gas, oil, etc., $2,154; equipment charges, $13,500; repairs, $2,073. Total cost for 9 months collection, $66,464; cubic yards collected, 71,373; cost per cu. yd., 93.1 cents.

Costs of Garbage and Rubbish Disposal.—Labor, $7,854; gas, oil, etc., $422; equipment charges, $3,600; repairs, $685. Total cost for 9 months disposal, $12,561; cubic yards disposed, 71,373; cost per cubic yard, 17.7 cents.

Mud-Jacking in England

In a discussion on concrete roads before the Institution of Highway Engineers, England, an engineer told of a somewhat unusual use of the mud-jacking method (which he calls "grouting") as follows. "At the foot of the Barnhorne cutting, the road left the good ground for marsh, and, naturally, trouble had been expected there. So that for a length of something like 120 ft. an unusually strong concrete road was provided, and was very fully dowelled. Within a few years the Catchment Board had drained the marsh, which had let the road down, and by 1945 the settlement had reached the extreme depth of 7 in. As the result of the grouting, the concrete road was raised up completely into place to within about ⅛ in. of its original position, without any breakage or failure whatsoever. The slab was very heavy."

Scum Breakers Aid in Sludge Digestion

(Continued from page 19)

Prüss circulator and one with no mechanical mixing device. He concluded after a year of operation that the Prüss digester produced 21% more gas with considerably less liquefaction of solids but he could not determine that the digestion process was hastened. Many sewage treatment plants in Germany are equipped with this type of digester. A Prüss type circulator was installed at the Coatesville, Pa., treatment plant in 1932. This has a rotating type of impeller near the roof of the tank, which can force the sludge either up or down the riser pipe. After several years of operation, sludge circulation by means of these pumps was discontinued with no noticeable difference in the digestion process.

At Eastleigh, England, a hand operated propeller has been installed in the gas domes to break up the sludge and thus facilitate the release of the gas.

(This is an abstract of a paper by Col. Gilbert which he presented at the Greenwich, Conn., meeting of the New England Sewage Works Association—Ed.)

Public Works Digests

Water Supply • Sewerage • Highways and Airports

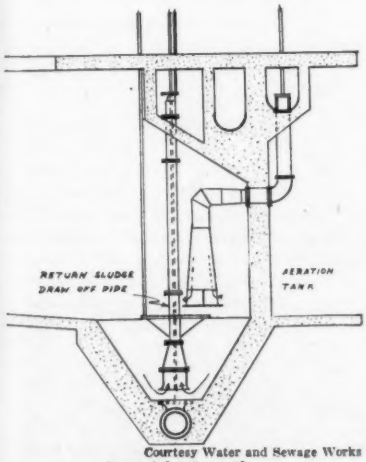
In this section are digested and briefed the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of the principal articles, in which the articles in each periodical are numbered consecutively throughout the year, beginning with our January issue.

The letter and number at the end of each digest refer to those used in the Bibliography. Numbers not found in the current Bibliography will be found in the one published the previous month.

The Sewerage Digest

Density Currents In Final Tanks

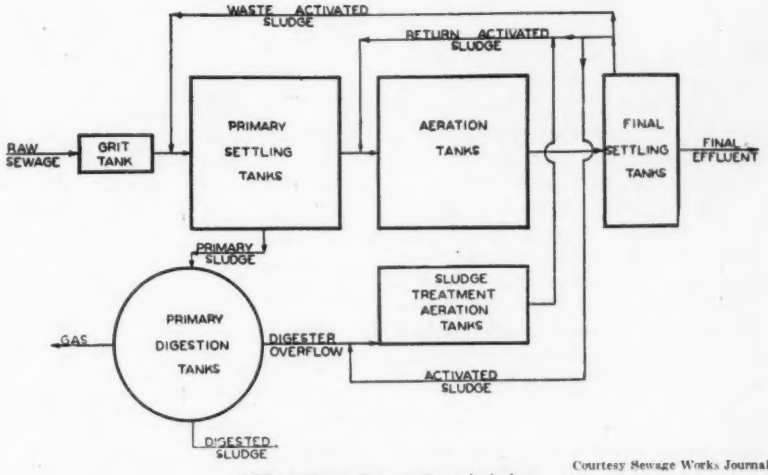
At the Camp Butner, S. C., activated sludge plant there were five final settling tanks 11 ft. deep, each of which received the mixed liquor through two inlets located 5 ft. 10 in. above the bottom; the effluent passing over an end weir 15 ft. long. By installing 125 ft. of trough weirs near the sides of and across one tank, the clarity of the effluent was improved. Further improvement was attempted by locating baffles at various points, some of which were beneficial, others the reverse. Best results were obtained by installing at each inlet a metal conduit which extended vertically to within about 6″ of the bottom, and flared from the inlet diameter of 8″ to an outlet diameter of 24″. The optimum results with these were obtained when the sludge was 12″ or more deep, and the inflow less than 1,000 g.p.d. per sq. ft. of tank, when there were no reverse currents on the surface of the tank.



Courtesy Water and Sewage Works

Drop inlet in tank.

From these studies the author concluded that the drop inlets are a great improvement, especially when the opening is below the surface of the sludge blanket; that they should be so designed as to present the minimum amount of mixing of the mixed liquor with the clear liquor of the tank in order to prevent the separation of the floc particles from the mass of sludge or mixed liquor particles. Such separated floc particles exhibit poorer settling properties than do the mass of mixed liquor solids.[G1]



Courtesy Sewage Works Journal

Adding digested to activated sludge.

Digested Sludge Aids Activated Sludge

At the Peoria, Ill., sewage treatment works the activated sludge was in a practically continuously bulked condition. Experimenting with various procedures to remedy this, it was found that digested sludge solids could be converted into activated sludge solids rather readily, and that the activated sludge so produced would be of low sludge index; also that when this low index sludge was mixed with an activated sludge of high sludge index the resulting index was the weighted average of the two. This was used as the basis of a procedure for controlling the sludge index—first, produce an acti-

vated sludge of low sludge index by adding digested sludge to activated sludge in an aeration tank and aerate the mixture until the whole is converted to an activated sludge; then add the low sludge index activated sludge so formed to a high sludge index activated sludge in the aeration tanks in such a manner that a desired condition of mixed liquor suspended solids be maintained.

In adjusting this procedure to the operation of the plant as a whole, it was found more convenient to use digested overflow from the primary digesters rather than bottom sludge from the secondary digesters. The digester overflow is mixed with return activated sludge from the final settling tanks and the mixture is aerated in the sludge treatment aeration tanks; then the overflow from these tanks is added to the normal return activated sludge to the aeration tanks. This was successful except for occasional shock loads of industrial wastes which caused the activated sludge to lose its clarifying properties, which it would not recover for periods as long as ten days, and a special procedure was adopted involving the intermittent use of sludge treatment tank sludge at a high rate.

Study of the effect on the digestion tanks showed that more gas was produced per pound of suspended solids in the raw sewage, but less gas per unit of population equivalent. The greatest effect of the process on the digestion tanks is to eliminate completely the problem created by digester overflow or so-called "supernatant liquor," which is added to the activated sludge system in the manner described.

The study shows that nitrate nitrogen is added to the influent to the activated sludge tanks, thus affording an immediate oxygen reserve which supplements the dissolved oxygen supply in that part of the aeration tank where the oxygen utilization rate is a maximum. The procedure requires somewhat greater pumping capacity for waste activated sludge and primary settling tank sludge; it requires no more air than the conventional process; it makes possible continuous high degree purification; increases materially the load capacity of an activated sludge plant; completely eliminates the supernatant problem; and transforms conventional sludge treatment from a sensitive process, incapable of continuous high degree purification when subjected to shock loads of dissolved organic material, to a rugged process with capacity for effectively purifying such shock loads.[C1]

Sewage Disposal In the United States

The population living in incorporated places in the continental United States was 83,766,000 by the 1940 census. In 1945, 76,716,000 population were served by sanitary sewers and 46,732,000 by treatment plants. Public water supplies served 15,859 communities, of which 7,745 had sewerage facilities and 5,685 had sewage treatment plants. Income from rentals was obtained in 613 cases. Treatment ended with land disposal in 138 plants, with screening in 97; sedimentation with sludge disposal in 2,715; and oxidation in 1868. Primary sedimentation was employed in 5,503 plants, of which 1,222 had mechanical sludge removal; 1,432 were septic tanks, and 2,467 were Imhoff tanks. Trickling filters were included in 1,671 plants, intermittent sand filters in 560, and contact beds in 80. There were 373 activated sludge plants, of which about 40% used diffused air aeration. Separate sludge digestion was reported by 1,462 plants. Sludge was dried in open beds at 3,883 plants, in covered beds in 319, and in lagoons in 82. Mechanical dewatering of sludge was practiced at 92 plants; incineration at 52; fertilizer production at 55. Digestion gas was used for heat at 728 plants and for power at 99. Of the plants employing separate sludge digestion which utilized the gas for power, none of the 37 in New England did so; 4.4% of those in the Middle Atlantic states; 5.5% in the Southern states; 12% in the Middle West; 3.1% west of the Mississippi; and 6% in the Far West.

Since 1938, there has been 100% increase in the number of plants employing secondary sedimentation and 30% in those employing chlorination; 24% increase in coarse screens; 37% reduction in fine screens; 331% increase in the use of shredders; 51% decrease in incineration; 54% decrease in grease separation as a separate practice; 63% increase in mechanical sludge removal; 67% increase in activated sludge treatment; 20% increase in Imhoff tank installations; 2% decrease in septic tanks; 47% increase in trickling filters; 7% increase in intermittent sand filters; 22% decrease in contact beds; utilizing sludge as fertilizer decreased 65%; separate sludge digestion increased 73%; mechanical dewatering increased 51%; incineration of sludge increased 79%; utilization of gas for power increased 96%.[E18]

Sewage Treatment In Germany

This paper is based on a recent visit to treatment plants in over thirty German cities. During the war primary emphasis was put on the recovery from domestic and industrial wastes of minerals, fertilizers and fuel. Digester gas was compressed and used as motor-vehicle fuel, while coal and electricity were used for sludge heating and power at the plant. The gas was delivered to consumers compressed to 200 atmospheres and containing 90-94% methane; the cost being about 30 cts for the power equivalent of a gallon of gasoline.

One method of treating phenolic wastes containing as high as 10,000 ppm of phenols was by the activated sludge process with the aid of nutrient salts containing nitrogen and phosphorus. An activated sludge plant which is being designed for 1,300,000 of Berlin's population is laid out in three groups

SEWAGE TREATMENT PLANT—GREENVILLE, SOUTH CAROLINA

MECHANICALLY CLEANED SCREENS—with intermittent automatic control. *Bulletin 258.*

GRIT CHANNELS—exclusive Camp chamber design and Regulator permit easy and instant variations in velocity. *Bulletin 249.*

GRIT SETTLERS—with conveyor and exclusive Hydrowash unit which removes grease and organic matter from grit. *Bulletin 249.*

GRIT ELEVATOR—vertical elevation of drained grit by exclusive design. *Bulletin 249.*

GREASE FLOTATION UNIT—removes grease and oils, oxidizes odors, and aerates by exclusive pre-treatment method. *Bulletin 260.*

SLUDGE COLLECTORS—for rectangular and circular tanks . . . can be furnished with helicoid cross conveyors. *Bulletin 253.*

TELESCOPING SLUDGE DRAW-OFF VALVE—permits visible control of concentrated sludge withdrawal. *Bulletin 253.*

AERATORS — mechanical air diffusion type provides thorough and adjustable oxygenation and circulation of liquor. *Bulletin 254.*

ROTARY DISTRIBUTORS — reaction and positive drive types with exclusive trouble-free oil seal. *Bulletin 257.*

RAPID MIX TURBINE – provides violent turbulence for chemical mixing . . . supplied with simultaneous air diffusion device. *Bulletin 255.*

DOWNFLO FLOCCULATION UNIT—for slow mixing and flocculation of chemicals in sewage treatment processes. *Bulletin 255.*

Send for instructive bulletins listed above

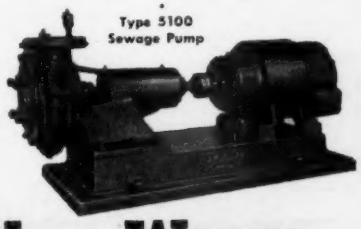
COMPLETE LINE . . .

Including many Exclusive Developments

Many years of close collaboration in the design of municipal and industrial waste treatment plants enable us to furnish a complete line of installation-tested equipment. Our staff of Sanitary Engineers is exceptionally well qualified to cooperate with consulting and operating engineers in suggesting the process of treatment and type of equipment best suited to individual needs. Additional modern plant facilities have increased our production capacity many times. Inquiries on new installations or improvements in existing plants will receive prompt attention.

SEWAGE AND SLUDGE PUMPS

American sewage and sludge pumps are designed to give outstanding service under severe conditions. Unusually strong and rugged in construction, they have ample factors of safety: generous shaft diameter, sturdy bearings, proper bearing span, finest materials, extra metal, careful inspection and testing.


Type 5100 Sewage Pump

AMERICAN WELL WORKS

IN OUR 78TH YEAR
104 North Broadway
AURORA, ILLINOIS

Pumping, Sewage Treatment, and Water Purification Equipment
RESEARCH · ENGINEERING · MANUFACTURING

Offices: Chicago · New York · Cleveland · Cincinnati · Kansas City · Sales Representatives throughout the World

When writing, we will appreciate your mentioning PUBLIC WORKS

of 3 sections each, each section operated independently. Treatment in one or more sections will be carried to a high degree of mitrification and its effluent recirculated to all the raw sewage, making the septic sewage more amenable to treatment and minimizing odors. A number of enclosed filters of the forced down-draft type, dosed at 3 or 4 times the conventional rate, have been constructed, the results from which were not impressive. Contact aerators have completely disappeared. Fish pools and sewage farms are falling into disuse. In most places the sludge is digested in tanks heated with rotated heating coils; a few using external raw sludge preheaters. Digester stirring is common. Earth banking of tanks is rare, cork or air-cell insulation being used to conserve heat.[L7]

Ground Garbage in Sewage Treatment

The amount of dry garbage solids produced by a community is about equal to the dry solids in its domestic sewage, but the percentage of volatile matter is somewhat greater in the former; the grease content is about the same or lower, and the nitrogen content 10% to 25% as great. Ground garbage settles fairly rapidly and it might be difficult to prevent its settling in grit chambers. When equal parts of ground garbage and sewage were mixed, in 1 minute 55% of the settleable solids settled, but only 7% of those in the sewage alone. Ground garbage gives poorer effluents when added to fresh sewage, may be slightly beneficial when added to stale sewage, and even more so when trade wastes are present. In general, there is an increase in the B.O.D. of the effluent when garbage is added, and in scum formation in the tank. The increase in B.O.D. would probably increase the load on trickling filters by about 1/3. The garbage will not particularly affect the results from activated sludge treatment; nor those from digestion, but the tank capacity should be increased at least in proportion to the increase in fresh solids, and greater vigilance is required to prevent trouble. Filter cake will have practically the same moisture content, with or without garbage. With 100% garbage added, the chlorine demand of the effluent from settled mixtures is increased by 20 to 50%.[C7]

Trickling Filters For Sulfite Wastes

Sulfite waste liquor is an acid waste from the manufacture of wood pulp, having 12 to 13% solids in solution, mostly organic, and lacking in nutrients required for bacterial growth. Nutrients necessary but not present must be added for satisfactory growth of micro-organisms. The necessity for treating these wastes arises primarily from their high oxygen demand and the consequent depletion of the dissolved oxygen content of water into which they are discharged. The principal oxygen demand arises from carbohydrates. Since it is found, in treating sewage, that methods of oxidation are more effective or more rapid than those of reduction, filters or activated sludge treatment seemed to be indicated, and experiments were conducted with high-rate filters. This waste has a pH value of 1.5 to 2.5, and this was raised to 3.0 by steam stripping, and a set of filters run with this, while another set was run with pH raised to 7.0 by use of lime. Ordinary sewage filter organisms were used for seeding the latter filters; but for the pH 3.0 waste a special organism was developed from molds and yeasts.

Among the conclusions reached from these experiments were the following: Free SO_2, and possibly loosely combined SO_2, in these wastes inhibits the growth of micro-organisms in filters, and steam stripping removes the free and over half the loosely combined SO_2. No other inhibitor has been isolated but there may be others. Filters treating pH 7.0 wastes are somewhat more effective in removing sugars and B.O.D. than those treating 3.0, but are more expensive to operate because of the lime needed. The organisms involved at pH 7 are yeast, molds and various types of bacteria; those at pH 3 to 4 are similar yeasts and a few molds. Filter activity decreases rapidly at temperatures below 22 degrees or 23 degrees C, but little additional advantage in operating at above 25 degrees C was observed, al-

though yeasts should function better at around 30 degrees C. The results from two-stage operation did not appear to be better than from one-stage.[C9]

Treating Synthetic Rubber Wastes

All wastes of any consequence from the synthetic rubber industry impart disagreeable tastes and odors to water and carry a heavy B.O.D. load. The odors are not removed at the same rate as the B.O.D. nor does self-purification remove them. In treating water containing these wastes for public consumption, coagulation was of little value; ozone was worse than useless; activated carbon completely removed tastes and odors if more than 100 ppm. were used; breakpoint chlorination gave variable results and would require careful control; aeration by diffused air produced some odor removal. These wastes are not necessarily toxic to a biological system, but treated alone they lack the nitrogen and phosphorus, and possibly other minerals, necessary for successful biological treatment; but when mixed with an equal volume of sewage in activated sludge treatment the mixture gave an 80% B.O.D. removal in 5 hrs. and 95% in 24 hrs., and 90% on trickling filters. By aeration, a biological floc can be induced which will reduce the B.O.D. 60 to 95% and produce effluents having odors of the order of 4 to 8.[C10]

Devices for Improving Operation

This article described various methods adopted at Army treatment plants for removing sand at lift stations, flushing grit lines, construction of operating gates, methods of grease and scum collection, a water level indicator, a relief valve, improved distribution by revolving distributors, sludge sampling, sludge recirculation, utilization of liquid sludge as fertilizer, and sewage samplers.[C11]

Dewatering Activated Sludge

The Northern Outfall Works treats an average of 60 mgd of London's sewage in an activated sludge plant. Due to the need for fertilizers during the war, experiments were conducted on methods of dewatering the 3,000,000 gal. per week of surplus activated sludge. Vacuum filtration, sludge pressing, and filtration on sand and other porous filters were studied. The first two involved expensive plant, conditioning chemicals and labor, and special attention was paid to air drying and draining. Sand 12" deep in beds covered with tarpaulins on a light framework was used for drying settled sludge with 1.45% suspended solids. With a sludge depth of 3" to 4" the liquor drained off in 6 hr., leaving ¾" to 1" of wet cake, which was dry enough to lift in 2 or 3 days. Then it was raked off with a moisture content of 50% to 60% and with considerable sand adhering to it. The sand was removed by riddling and the sludge was spread onto drying beds and air dried for 7 to 14 days,

when the moisture was 20% to 30%; then the cake was crushed in a hammermill crusher to pass ⅛" holes and had a moisture content of 8% to 15%. It had an average sand content of 34.75% (on a dry basis), and to reduce this, experiments were made by covering the sand bed with zinc plates 1/16 in. thick containing ⅛ in. perforations. Each plate was fastened to a frame with handles by which it and the retained sludge could be lifted off the sand bed. When removed, the sludge was ⅛ to ¼ in. thick with 41.8% to 26.2% moisture and no adhering sand, and was dried sufficiently for disintegrating 11 days sooner than sludge run onto a plain sand bed at the same time. Use of these plates would permit use of smaller filter and drying areas, less labor in removing and riddling the sludge, and produce sand-free fertilizer.

Another idea tried was to make a filtering surface that would be pervious to water but dense enough to exclude sludge solids, from which sludge cake could be picked up easily and without other adhering matter. Porous concrete was tried but proved unsatisfactory; as soon as the sludge was poured onto the concrete, the solids settled and clogged the surface with a gelatinous film. However, because of its advantages it is proposed to experiment further with the porous concrete idea.[D1]

Controlling Digester Scum

The digester is the ideal place for disposing of grease and scum because it increases the amount and value of the gas produced. So long as the scum does not exceed a foot or two in depth and has a soft consistence, no special control measures are necessary. Measures to be used when control is necessary are positive submergence, recirculation of digester liquor, control of temperature in the scum zone and ammonia-nitrogen control. (The first two are described at length in G3). It is the scum itself that needs the high temperature. With thermostatic control of external heating it is possible to keep the scum temperature within ½ degree of the optimum.

At several plants, heavy scum accumulations have been caused to digest rapidly by adding relatively small amounts of a compound containing ammonia nitrogen, such as ammonium sulphate. This is added in 50 to 100 lb. doses until a total of 30 ppm. of ammonia nitrogen have been added to the tank and circulated. Too rapid addition may cause foaming.[M2]

Heating Sludge With Live Steam

At the Los Angeles County disposal plant and the San Diego, Calif., plant, the sludge is heated by injecting live steam into it in concentration tanks while it is being pumped to the digesters. At San Diego the digester temperature is maintained at 96 to 99 degrees. Raw sludge is being pumped almost continuously. Where sludge is pumped direct to the digester, steam may be injected into the pump suction lines. Or it may be injected directly into the digester through a few outlets —particularly suitable for small plants. It is possible that the steam may destroy a few bacteria, but the volume sterilized would be very small and would be reseeded quickly. The submerged gas burner (see "Digest" for August) gives promise of efficient use of heat.[M5]

Copper-Bearing Wastes And Sludge Digestion

Kenosha, Wis., sewers have at times received copper-bearing wastes which greatly reduced digestion in the digestion tanks at the treatment plant. This was the case when the plant started operation in 1940, and gas production during the first 2½ months averaged only 0.5 cu. ft. per lb. of volatile solids added to the digesters, during which time the copper concentration in the digesters gradually increased to 3,000 ppm. The copper-bearing waste waters were then excluded from the sewers and the gas production increased in the following four months to 11.3 cu. ft. This experience was repeated in 1943 when a war industry discharged copper-bearing wastes into the sewer. When the gas production had fallen to 8 cu. ft. per lb. the bottom sludge of the digester had a copper content of 0.5% on a dry solids basis. A month later this had increased to 1.3% and the gas production had fallen to 4 cu. ft. The copper concentration in the sludge and in the supernatant, calculated on a dry basis, were practically the same—4,250 ppm. in the supernatant and 4,000 ppm. in the bottom sludge at one time. When operating the tank at thermophilic temperatures, copper had about the same relative inhibiting deleterious effect.

Not all copper-bearing wastes necessarily have these toxic effects on digestion, but it can definitely be stated that copper hydroxide and hydrated copper sulphate are so toxic; and if present in sufficient quantity can put digesters out of operating condition entirely.[C5]

Increasing Sedimentation Efficiency by Preaeration

The Denver, Colo., treatment plant includes a preaeration tank equipped for spiral flow air diffusion, designed for a 15 min. detention period and an air capacity of 0.02 cu. ft. per gal.; a flocculation tank of the same capacity equipped with Dorr flocculators, and four Dorr clarifiers of 140 ft. diameter, affording a detention time of 1.96 hr. at design flow. Studies were made to learn how these could be operated so as to secure results better than those normally expected from primary treatment. Three of the experiments involving return of part of the raw sludge from the primary tanks to the sewage entering the preaeration tanks gave promising results and such return was developed. A box giving a retention period of 1 hour for the return of 25% of the raw sludge was equipped with air diffusion grids for applying air at the rate of 3 cu. ft. per gal. of sludge (later reduced to 0.3 cu. ft). In this box the return sludge was aerated before its admixture with the sewage entering the preaeration tanks. With this operating, the removal of suspended solids in the sedimentation tanks increased from 70% to 78%, and the B.O.D. removal increased from 45% to 54%. This temporary box 5 ft. 6" deep was replaced with a concrete one giving 3 ft. depth of liquid, but the latter gave inferior results until the depth was increased 6".[C3]

Bibliography of Sewerage Literature

C *Sewage Works Journal*
November

1. Digested Sludge—An Aid to the Activated Sludge Process. By L. S. Kraus. Pp. 1099-1112.
2. Modernization of the B.O.D. Test for Determining the Efficiency of Sewage Treatment Processes. By Clair N. Sawyer and Leland Bradney. Pp. 1113-1120.
3. Preaerated Raw Sludge Recirculation Increases Primary Sedimentation Efficiency at Denver. By C. P. Gunson. Pp. 1121-1126.
4. Control of Sewer Usage at Detroit, Mich. By Clyde L. Palmer. Pp. 1127-1129.
5. Effects of Copper-Bearing Wastes on Sludge Digestion. By H. T. Rudgal. Pp. 1130-1137.
6. The Transmission of Disease by Sewage. By Robert N. Clark. Pp. 1138-1143.
7. Effects of Ground Garbage on Sewage Treatment Processes. By Willem Rudolfs. Pp. 1144-1150.
8. Sewage Treatment at an African Native Community. By R. S. Young, A. J. Hall and A. W. Darvall. Pp. 1151-1154.
9. Treatment of Sulphite Waste Liquor on High Rate Trickling Filters. By Richard G. Tyler, William Maske and Robert Brewer. Pp. 1155-1168.
10. A Study of Wastes from the Synthetic Rubber Industry. By O. R. Placak and C. C. Ruchhoft. Pp. 1169-1181.
11. Ingenuity—Tool of the Operator. By R. W. Simpson. Pp. 1182-1191.
12. Small Plant Operation. By Herbert O. Johnson. Pp. 1191-1194.
13. Facts About Chlorine. By Wilmer H. Koch. Pp. 1194-1198.
14. Interesting Extracts from Operation Reports. (Winnipeg, Detroit, Dist of Columbia, Green Bay, Wis., and Worcester, Mass.) Pp. 1202-1211.

D *The Surveyor (England)*
November 15

1. Experimental Work at the Northern Outfall Works, London. By E. H. Vick. Pp. 883-886.

November 22

2. Biological Detection of Pollution of River Water. Discussion. Pp. 909-912.

November 29

3. Sewage Disposal as a National Problem. By E. J. Hamlin. Pp. 919-922.

E *Engineering News-Record*
December 12

1. Kiln Furnace for Rubbish Incineration. Pp. 109-111.

G *Water & Sewage Works*
November

1. Density Currents in Final Settling Tanks. By Stephen R. Kin. Pp. 441-445.
2. Nomograph for Determination of Sludge Filtration Data. By Charles W. Gard. Pp. 446-447.
3. The Scum Problem from the Operators' Standpoint. By Joseph Doman. Pp. 451-453.

H *Sewage Works Engineering*
December

1. Waste Disposal—The Dow Way. Pp. 632-634, 665.
2. Controlling Filter Flies. By George A. Rhame. Pp. 639-640.
3. Sodium Nitrate Controls Odors in Cannery Lagoons. P. 641.
4. Operation of Sewage Screens. Pp. 647-648.

M *Water & Sewage*
November

1. Special Features in Oshawa's New Sewage Treatment Plant. Pp. 13, 54.
2. Four Scum-Control Procedures for Sewage Digesters. By Harry E. Schlenz. Pp. 20-21, 51.
3. Dual-Fuel Engines for Sewage Treatment Plants. By A. M. Boehm. Pp. 22, 50.
4. Heat Distribution in Sludge Digestion Tanks. By Willem Rudolfs. Pp. 23-24.
5. Sludge Heating with Live Steam. By A. M. Rawn, Vinton W. Bacon and Harvey F. Ludwig. Pp. 25, 50.
6. Operating an Incinerator for Sewage Sludge. By Mark B. Owen. Pp. 25, 49.
7. Operating Problems at Sewage Treatment Plants. Pp. 28, 45.
8. Pollution Control Procedure. By Milton P. Adams. Pp. 42-43.
9. Service Rendered as a Basis of Sewer Cost. By F. M. Veatch. Pp. 44-45.

P *Public Works*
December

1. Effect of Variable Flow on Sedimentation of Sewage. Pp. 21-22.
2. Inventory and Stock Control for City and County Public Works Departments. By W. F. Freeborn and A. A. Kirkbright. Pp. 31-32.

The Waterworks Digest

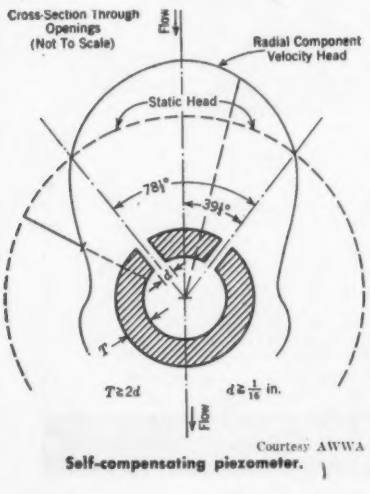
Pipe Flow Formulas

The pipe flow formulas in common use by engineers are empirical and admittedly imperfect and limited in scope. But uncertainties involved in their use are not markedly greater (if not even less) than other uncertainties inherent in the design of water supply systems, such as the effect of pipe roughness, and the precise amount of water to be carried. But it is desirable to use the most accurate computation methods available, and during the past 20 or 30 years a systematic attempt has been made to develop rational flow formulas. One of these, that for laminar flow, is theoretically exact; and that for smooth pipe is accurate beyond practical needs; neither of which are of practical use for designing water mains. C. F. Colebrook developed a formula for turbulent flow in rough pipes which is ideal in its conception but requires further substantiation and the development of a definite scale of values for its roughness factor k. This formula is

$$\frac{1}{\sqrt{f}} = -2 \log \frac{\frac{k}{D}}{3.7} + \frac{2.51}{R\sqrt{f}},$$

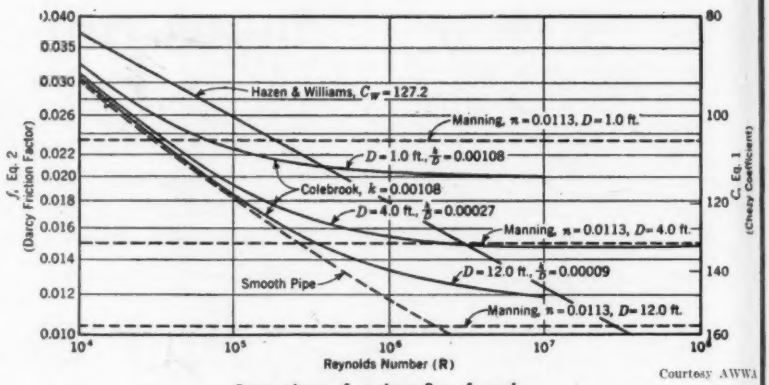
in which f is the friction factor in the Darcy formula $H = f \frac{L V^2}{D^2 g}$, D is the diameter of the pipe, and R is the Reynolds number. $R = \frac{V D}{\nu}$, in which V is the mean velocity and ν is the kinematic viscosity. If and when the values of k are determined for various types of surfaces, the Colebrook equation should replace all others. L. F. Moody has proposed tentative values of k, among them: for steel or wrought iron, 0.00015; asphalted cast iron, 0.0004; cast iron 0.00085; concrete, 0.001 to 0.01.

A research program should be directed first toward the collection of friction data on the new types of pipe, suitable for use in either old or new formulas; and second, toward the development of information for substantiating or improving the new universal equations, or for developing better ones.[A140]



Courtesy AWWA

Self-compensating piezometer.



Courtesy AWWA

Comparison of various flow formulas.

Measuring Velocity Of Flow in Mains

For making flow tests in water mains, the author considers the Venturi meter to be the most accurate device, but one which it seldom is practicable to install for this purpose. Velocity-type meters are acceptable if in good adjustment. Pitot tubes offer a fairly convenient method of measuring the velocity. The salt-velocity method, though quite accurate, is seldom practicable for measuring potable water.

For measuring pressure heads, the simplest accurate indicator is the water manometer. Transparent plastic tubing is ideal for this purpose. For high heads, mercury or some fluid with specific gravity between that of water and mercury is used. The piezometer opening should be 1/16" or a little larger. Instead of a hole tapped in the wall of the pipe, the self-compensating piezometer is recommended. This is made by using a tube which can be inserted into the pipe through a corporation cock, and drilling in this tube two radial holes making an angle of 78½ degrees with each other and on the same circumference of the tube. If this is rotated so that the direction of flow bisects this 78½ degree angle, the true static head will be indicated; the indicated head being lower in any other position. A distinct advantage of this type of piezometer is that the openings can be placed near the center of the pipe, where the readings obtained are unaffected by turbulence caused by irregularities in the pipe surface.[A141]

Control of Scale and Corrosion

Scale is defined as "incrustation or deposits formed by calcium and/or magnesium compounds." The principal factors causing scale are calcium, alkalinity, pH, temperature, and dissolved solids. Corrosion involves these factors and also flow rate, dissolved gases, acid type pollution, and microbiological fouling. Temperature in the lower ranges and dissolved solids are more important factors with corrosion than with scale. For preventing scale formation, if the stability index is between 6 and 4, the use of a polyphosphate type of treatment is advisable; if the index is below 4, it is advisable to pre-soften or otherwise lessen the effect of one or more of the factors to a point where polyphosphate treatment is economical.

Where calcium softening is used, magnesium is left in the water and frequently forms a silicate or hydroxide scale; against which polyphosphates provide some protection but it is usually more economical or practical to reduce the pH to a point where these deposits are prevented.

Corrosion increases with rise in temperature to 160°-180° F. There is considerable evidence that corrosion de-

When you need special information—consult the classified **READERS' SERVICE DEPT.**, *pages 63-65*

creases as the silica content of the water increases. As the rate of flow increases, more corrosive materials reach the surface of a pipe, also more corrosion inhibitors. The presence of corrosive gases in high amounts increases the amount of corrective treatment necessary; but it is usually more economical to add treatment or inhibitors than to de-aerate. Slime coatings on pipes prevent inhibitors from coming in contact with the metal, and corrosive bacteria thrive under them. Under-treatment with any corrosion inhibitor is of little value and may be a detriment.[X2]

Helicopter Takes Water Samples

In making a study for locating a new water intake in Lake Erie, the Western New York Water Company has employed a helicopter for taking water samples by means of a specially designed sampler attached to a cable and lowered into the lake. In a few minutes the samples are delivered at the laboratory, the helicopter landing on the sedimentation basin.[F1]

Watershed Management

Studies made by the Southeastern Forest Experiment Station on the 4,000-acre Coweeta Experimental Forest have shown that, for the southeastern United States at least,

1. Summer temperatures favor high evaporation from the soil and maximum transpiration from vegetation. These conditions make it necessary for us to know what type of vegetation will afford maximum soil protection with minimum transpiration.

2. Because of high annual temperatures and active biological action throughout the year, it is difficult to maintain organic material and good structure in the soil. Good soil structure is a requisite of favorable infiltration and transmission of water through the soil for normal storage of ground water.

3. High natural erosion potentials that create critical problems of watershed management are, among others, rolling and steep topography; open winters with constant freezing and thawing that loosens the surface of exposed soils, and heavy rains throughout the year.

4. Abandonment and neglect of land that has been depleted by agriculture has been the principal source of serious impairment of regional water resources. Rehabilitation of the soil on such land through the establishment of deep-rooted vegetation will benefit all water users, and merits active public interest and support.

5. The growing and cutting of timber on watersheds may be a desirable way of maintaining the best possible soil protection, while preventing at the same time excessive transpiration.

6. Watershed studies have indicated that if proper precautions are taken, many municipalities cannot only supplement their income by harvesting timber from municipal watersheds without jeopardizing water quality but also increase their total water yields.[X7]

Most Productive Well Field

The Wabash River Ordnance Works, located in southwestern Indiana, used water at the rate of 72 mgd average, 88.7 mgd max. day, which it obtained from six Ranney-type wells, spaced about 2,000 ft. apart along the Wabash river on a broad terrace. They tap an aquifer of sand, gravel and boulders about 100 ft. thick. A typical well consists of a reinforced concrete caisson 13 ft. inside and 16 ft. outside diameter, extending about 55 ft. below normal water level and 45 ft. above. Near the bottom, nine lines of slotted 8" well casing, varying from 50 to 250 ft. in length, project horizontally into the aquifer, each controlled by a gate valve. The water is drawn from the well by three 600 hp motors, each driving a deep-well pump capable of lifting 5,000 gpm against 400 ft. head. The temperature of the water follows that of the river in its variations, with a lag of 2 to 3 months. Although the river

water is polluted, coliform organisms have been found in the well water only once, when the river in flood had risen above the terrace on which the collectors are located.[L1]

Water Softening

Calcium and magnesium can be removed from public water supplies by either precipitation or ion exchange. Calcium temporary hardness is the cheapest and easiest to remove. Magnesium temporary hardness requires twice as much lime. Calcium permanent hardness requires chemicals costing 4 or 5 times as much as the temporary hardness. Highest in chemical cost is magnesium permanent hardness. Reduction of hardness to 100 ppm has been the general standard, but 25 ppm is quite possible by modern methods.

Zeolite softening is better adapted to small users and unskilled operators. It produces no sludge, but the brine waste can be a nuisance. Zeolite softening does not remove odor, taste, turbidity, color or bacteria. It leaves an equivalent of sodium for all of the calcium and magnesium removed, which may detract from palatability and create a problem of stabilization against corrosion.[P2]

German Water Supplies

About 75% of German public water supplies are obtained from ground water. Treatment for removal of carbon dioxide, iron and manganese is common. Various types of infiltration galleries are used, which are worthy of study; as are also their designs of rapid sand filter plants, especially the use of air and water for washing, the design of inlet and wash water channels, and filter underdrain systems. Some of the newer storage reservoirs are superior in design and equipment to equivalent American structure. Pumping equipment in the large cities compares favorably with American standards. Most of the fire hydrants are underground but the trend is toward aboveground hydrants.[A146]

Chlorine Dioxide For Taste and Odor

Greenwood, S. C., obtains its water from a shallow pond and is troubled with tastes and odors. The ammonia-chlorine process was not entirely successful in remedying this, and activated carbon had to be used in such high doses as to give unsatisfactory filter operation. In October 1944 a chlorine dioxide generator was installed and the tastes and odors at once disappeared. Chlorine dioxide is 2½ times as powerful an oxidizer as chlorine, but is much more expensive. Therefore, chlorine is used for sterilization, followed by chlorine dioxide, which destroys all the remaining organic matter. At Greenwood, the chlorine dose for the incoming water is from 1.25 to 2.0 ppm in cool weather, to 4 to 6 ppm in warm weather, sufficient to give a residual of 0.1 to 0.2 ppm after filtering. After coagulation and filtration, 0.5 ppm of chlorine dioxide plus 0.1 ppm of chlorine is added to the water ahead of the clear well.[X4]

Aluminum for Waterworks Structures

Aluminum in rolled form has a base price of 20 cts. a lb. as compared to 2½ cts. for steel, but weighs only 1/3 as much. It is highly resistant to corrosion in water, is easily fabricated and erection costs are reasonable. In Macon, Ga., a 500,000 gal. elevated tank has been constructed with an all-aluminum roof, ladders and other details. A number of small all-aluminum water tanks and towers have been erected at a cost about 35% more than similar steel structures; aluminum bolts and rivets being used, as welding aluminum is not desirable. Large all-aluminum tanks would probably cost 35 to 45% more than steel, but would not need painting or other protection against corrosion. Uncoated aluminum pipe would cost about 10% more than steel coated with bitumastic.[X6]

Maintenance At Filter Plants

The principal considerations in filter plant operation, in order of importance, are: 1—safe water, 2—maintenance, 3—cleanliness. To maintain equipment

properly, the proper tools must be provided and kept on a tool board when not in use. They should be cleaned after each use and replaced at once if broken or lost.

Oil, grease, packing and paint are probably the cheapest and most important maintenance materials. A mimeographed schedule showing name of equipment, types of grease or oil to be used, frequency of lubricating and date carried out, is a simple way of checking, and is best done by one man. Regular checks should be made of the filter sand and for hard spots above the underdrains. Mud balls should be kept at a minimum. Gauges and meters should be kept in condition and checked. Dry feed chemical machines should be checked regularly. A chlorine leak must be repaired immediately. Hydraulic valves should be checked frequently for leaks and the packing nuts tightened.[63]

Bibliography of Waterworks Literature

E *Engineering News- Record*
November 28

1. Diatomite Filters Offer Advantages in Industrial Applications. P. 57.
2. Valparaiso, Chile, Water Shortage Hastens Plans for New Supply System. By A. T. Cook. Pp. 69-70.
3. Stanton Diagram Modification Gives Direct Solution for Pipe Flows. By Henry J. Miles. Pp. 70-71.

December 12

4. Spillway Energy Dissipated on the Face of a Dam. Pp. 99-101.
5. Ground Water Pollution in California Points to Industrial Waste Discharges. P. 101.

F *Water Works Engineering*
November 27

1. Helicopter Used in Taking and Delivering Water Samples. Pp. 1388-1389.
2. Corrosion Control. P. 1399.

G *Water & Sewage Works*
November

1. An experience with Chlorine Dioxide Treatment. By Allan G. Davenport. Pp. 424-425.
2. Hydraulics for the Practical Water Works Man. By Robert W. Angus. Pp. 426-429.
3. Value of Maintenance in Filtration Plants. By A. E. Clark. Pp. 431-432.

L *Civil Engineering*
December

1. Induced Infiltration Supplies Most Productive Well-Field. By Raphael G. Kazmann. Pp. 544-545.

M *Water and Sewage*
November

1. Progress in the Treatment of Water for Taste and Odor Control. By Norman J. Howard. Pp. 14-15, 54.

P *Public Works*
December

1. Factors in Selecting and Purchasing Deep Well Pumps. By Frank E. Harley. Pp. 17-18, 34.
2. Water Softening. By Charles H. Spaulding. Pp. 27-30.

X *Southeastern Section, A. W. W. A.*
December, 1946

1. pH Measurement and Its Application to the Water Treatment Field. By R. A. Barnes. Pp. 10-20.
2. Technical Approach to Scale and Corrosion Control in Potable Water Systems. By J. A. Holmes. Pp. 21-35.
3. City of Savannah Water System. By R. R. Adams. Pp. 36-44.
4. The Use of Chlorine Dioxide in the Water Supply of Greenwood. By F. W. Chapman. Pp. 45-49.
5. Modern Distribution Shop Practices. By T. E. P. Woodward. Pp. 52-57.
6. Aluminum for Waterworks Structures. By John W. Perryman. Pp. 58-61.
7. Watershed Management in the Southern States. By C. R. Hursh and J. A. Lieberman. Pp. 62-72.

X *Journal, Western Society of Engineers*
September

8. Chicago's South District Filtration Plant Nears Completion. By W. W. De Berard, F. G. Gordon and John R. Baylis. Pp. 120-135.

Water Works Data From Pasadena

The annual report of the Pasadena, Calif., Water Department for 1945-46 contains data on pumping costs. The cost of deep well water pumping averaged 5.05 cents per 1000 cubic feet lifted 100 ft. This is equivalent to 6.73 cents per million gallons lifted one foot. The cost of pumping water in booster plants was 4.76 cents per 1000 cu. ft. lifted 100 ft., or 6.35 cents per million gallons lifted one foot. The average lift in deep well pumping was 287 ft., and in booster pumping it was 91 ft. The rate paid for power was not stated.

At the end of the year there were 1,980,124 ft. of pipe in the distribution system, and 4,083 valves in service, or one to each 485 ft. of pipe. There were 1,846 fire hydrants or one per 1,073 ft. of pipe in the distribution system.

Philadelphia to Install Ozone Treatment

As part of its $10 million first stage interim program for the rehabilitation of its present water treatment facilities, the City of Philadelphia has awarded the contract for ozonation equipment and its installation at the Belmont filtra-

tion plant to Welsbach Engineering & Management Corporation, Philadelphia. The equipment will be supplied by Ozone Processes, Inc., a wholly owned Welsbach subsidiary.

This ozone installation, to be the largest in the United States, will have a producing capacity of 1,250 lbs. of ozone to treat 36 million gallons of water daily. Ozone will be applied to the raw water ahead of coagulation and filtration to oxidize soluble taste, odor and color-producing impurities. The installation will be based on extensive pilot plant tests made by water bureau engineers over a two-year period.

"Pneumatic Control Valves and Controller Accessories," Bulletin 277-1, 36 pages, is published by The Foxboro Company, Foxboro, Mass. The previously familiar valve bulletin has been completely revised and much new material has been added. Among these are: a color page showing the identifying enamel finishes offered on Stabilflo Valves, corresponding with the color code of the American Standards association; plates and tables of specifications for control valves, needle type valves, poppet valves and butterfly valves; separate sections on the Vernier Valvactor for accurate positioning of valve plungers, and on air switches and sub-panels for remote valve control. An appendix contains information on computing valve sizes, with tables and formulae for determining the size of the correct valve for a contemplated installation. Air filter sets, ventilating dampers, and other pertinent accessory equipment is illustrated and described on other pages.

Close-Coupled Vertical Pumps.—A new, 20-page bulletin "Peerless Vertical Close Coupled Turbine Pumps" describes and illustrates the specialized application of Peerless turbine pumps to industrial, municipal, engineering and agricultural installations where short pump settings are encountered and where there is a strong necessity for deep well turbine pump power and capacity in these applications.

Copies of this bulletin (B-159) may be obtained from the manufacturer, Peerless Pump Division, Food Machinery Corporation, 301 West Avenue 26, Los Angeles 31, California.

Soda Ash.—Solvay Sales Corporation has issued a new edition of Solvay Technical & Engineering Service Bulletin No. 5, "SODA ASH." This new 64-page bulletin contains chapters on the properties of soda ash, bulk shipments, storage, conveying and elevating, unloading of bulk, unloading of bags and barrels, weighing, proportioning and feeding devices, sampling and analysis, precautions and conversion tables. Sent on request to any branch office of the Solvay Sales Corporation or to their Advertising & Sales Promotion Department at 40 Rector Street, New York 6, N. Y.

Synchronous Motor Control.—Data, and 45 diagrams, showing how, when, why and what. Selection chart, connection diagrams, etc. 20 pages. Ask for "ABC of Synchronous Motor Control." Electric Machinery Co., Minneapolis 13, Minn.

Automatic Flow Equipment & Methods.—Bulletin No. 1200 deals with automatic flow responsive equipment and methods in continuous process operation. Photographs of chemical proportioning equipment and typical installations are supplemented by many flow diagrams and detail drawings. The Proportioneers method is clearly explained and the operation of the equipment is demonstrated by two-color diagrams. A complicated subject has been made surprisingly simple by the careful planning and arrangement of the bulletin, permitting selection of equipment for most treating, sampling, blending, and diluting applications. If an engineer knows the maximum main line flow and the maximum requirement of secondary fluid flow, he can determine and specify exactly what equipment he requires. Each step is clearly designated in the bulletin and the selection proceeds in logical sequence. A copy may be obtained from %Proportioneers, Inc.%, Providence 1, R. I.

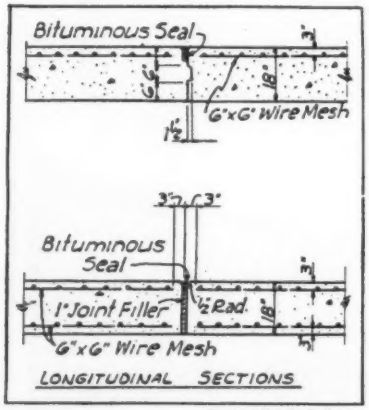
The Highway and Airport Digest

Runway Paving At Eglin Field

The runway pavements for 300,000 lb. gross loads at Eglin Field, Florida, are laid on soil compacted to 102% to 104% in all fill sections, and exceeding 100% in the top 2 ft. of all cut sections (modified AASHO density). Much of the compaction was obtained by use of standard rubber-tired grading equipment, with wobbly-wheel rollers in places. The runways are laid on a 3" to 4" sand-asphalt sub-base. The base consists of three 3" layers of hot plant-mix sand asphalt, with a bituminous tack coat between layers and a top seal coat.

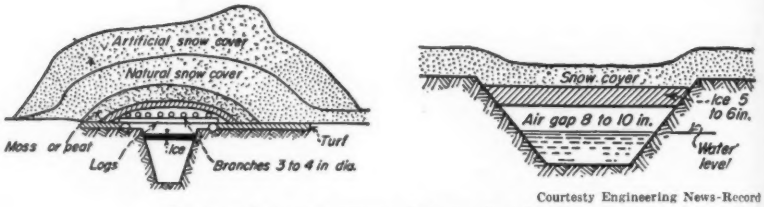
Concrete aprons for 300,000 lb. aircraft were given a uniform thickness of 18", with reinforcement mesh along the edges and at joints instead of thickened edges. Keyed longitudinal construction joints were spaced 25 ft. apart, and longitudinal expansion joints 250 to 325 ft. apart. Transverse dummy groove joints are 25 ft. apart and expansion joints 150 to 175 ft. A 15" thickness of concrete was poured first and thoroughly vibrated, the reinforcement placed, then the top 3" was placed, vibrated and finished.

For the asphalt work the contractor used twin plants, each with dual driers, which had a combined capacity of 300 tons per hour and averaged 250 tons day in and day out. Cores 40" in diameter for testing were cut from the 18" concrete pavement, each core weighing about 1800 lb.[N1]



Courtesy Roads & Streets

Paving joints at Eglin Field.



Courtesy Engineering News-Record

Covers and air gaps prevent drainage ditch freezing.

Solving the Nalyed Problem

"Nalyed" is the Russian name for surface ice formation in perma-frost regions, which damages buildings and other structures and makes roads impassable. Nalyeds may be formed by surface water, or by underground water forced to the surface by some obstruction. For preventing the latter, general drainage of the area in shallow ditches removes the water. Freezing belts are formed by ditches 20" to 40" deep and 10 to 15 ft. wide, which hasten the freezing of the underlying soil, the frozen soil presenting a barrier to the underground flow, which therefore rises and freezes there instead of at the protected structure. To prevent the underground barrier thawing in the spring, the ditch is filled with 12" to 16" of moss. Surface barriers may be used, in the form of either earth levees, or a timber barrier 6 or 8 ft. high covered with snow. The water may be drained from springs to locations where it would be harmless, in ditches covered with branches, moss and snow. For intercepting stream flow, an ice dam is constructed across the river by digging a trench part way through the surface ice, which hastens freezing of additional ice below it, and the ditch is successively deepened until the ice reaches the bottom of the river. A road acts as a freezing belt, and to prevent the damming back of the water there, drains are built across the road to carry the underground flow.[E2]

Snow Control On Ontario Highways

Until a few years ago the Ontario Dept. of Highways contracted snow plowing to owners of 5- to 7-ton trucks, but contractors' equipment could not be relied upon unless it was completely reconditioned after its summer jobs. In recent years the divisions have been supplied with plows for department-owned trucks, supplemented by heavier trucks where necessary. Equipment for the average district consists of two 200 hp 4-wheel-drive trucks equipped with heavy-duty V plows, and one 125 hp 4-wheel-drive truck with snow plow, wing and winch. Each foreman's truck is equipped with a one-way plow for cleaning up after the big plows have passed. The department has 300 snow removal units which are mounted on 2½-3-ton trucks. For high speed and power, 5-ton 200 hp diesels are used. Light V plows are used for quickly removing wet snow before it can freeze. Three blower plows are used for banks too heavy for V-plows. For making icy roads travelable, a mixture of sand and rock salt or calcium chloride is spread. Four hours after this, a bulldozer can scrape the ice off readily. This season 4 or 5 force-feed loaders will be used.[02]

Coarse-Graded Base-Course Materials

As a result of an investigation to study the effect of variations in plasticity index on the stability of base-course mixtures, the U.S. Public Roads Administration concluded that:

1. Mixtures meeting the grading requirements of the A.A.S.H.O. specification for type B-1 base-course materials should also conform to the plasticity index requirement for best results under traffic even though the mixtures contain less than 40 percent of material passing the No. 10 sieve.

2. A material meeting the grading requirements and having a definite and measurable plasticity index within the specification limits is to be preferred to absolutely non-plastic materials having similar gradings and is decidedly superior to those having appreciably higher plasticity indexes.

3. Although the material having a plasticity index of 9 gave fairly satisfactory service, except in the latter portion of the tests run with high water elevation, the possibility of the occur-

rence of conditions approaching complete saturation at some time during the life of a base course makes the present A.A.S.H.O. specification limit of 6 for the plasticity index a desirable, if not a vitally necessary requirement.[06]

Maintenance of Highway Equipment

The Missouri State Highway Dept., in maintaning some 16,000 miles of state highways, uses 665 trucks, 344 motor graders, 237 tractors, 93 pull-type graders, 241 pick-ups, 177 passenger cars, and 289 miscellaneous pieces of equipment, including power shovels, rollers, air compressors, concrete mixers, asphalt distributors, etc. This is owned by the equipment division and rented to the other divisions of the department. For the efficient and economical operation of this equipment the division keeps cost records of each piece and has perfected a check-up system of preventive maintenance. Four general inspectors travel continually throughout the state inspecting equipment, and report current or impending break-downs. Also each of the ten division offices employs 3 traveling mechanics for making on-the-spot repairs, and has a garage foreman and 3 to 5 skilled mechanics at division headquarters to make repairs too large to be made on the job. The inventory of the maintenance equipment at the largest headquarters is maintained at about $400,000 worth of repair parts and supplies and at the other nine at about $25,000 each. At the former are performed the large jobs such as reboring large motor blocks, straightening frames of large tractors and motor graders; while the smaller headquarters repair crawler tracks, replace pistons, etc. About 50% more equipment than listed above is needed, especially motor graders and 1½ and 2-ton trucks.[E1]

Ditch Retards To Prevent Erosion

Ditch retards to prevent ditch erosion can be constructed from vegetation at much less cost, and be more effective, than from rock, except where there is plenty of rock along the right-of-way. Bermuda sod retards are constructed of sod cut into blocks and planted in trenches. In shallow ditches with steep gradients, old burlap bags are filled with moist sod placed in the ditch and well tamped. Rock retards are made of stone not less than 8″ x 12″ x 6″, without mortar. In mulch sodding (for large areas), the sod is chopped into discs, dumped and spread on the prepared surface and rolled, and thoroughly soaked with water.

For stabilizing shoulders, cut-back asphalt is used, generally covered with a light seal coat. On many miles of Texas highway, the shoulders have been stabilized by road-mix methods, using road oils or cut-back asphalts, usually receiving a light asphalt seal coat.[P1]

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 63-65*

Number of trucks and combinations with values of C—

Region	Over 750			Over 800			Over 850			Over 900		
	1945	1944	1942	1945	1944	1942	1945	1944	1942	1945	1944	1942
New England	9	8	5	4	4	2	2	1	1	1	1	0
Middle Atlantic	18	20	13	9	11	8	5	4	4	2	2	2
South Atlantic	5	5	2	3	2	1	1	1	0	1	0	0
East North Central	28	15	11	22	11	7	14	6	5	8	4	2
East South Central	0	1	0	0	0	0	0	0	0	0	0	0
West North Central	8	2	1	3	1	0	2	0	0	1	0	0
West South Central	1	1	2	1	1	1	0	1	1	0	0	0
Mountain	22	16	21	16	10	15	11	7	11	6	3	8
Pacific	89	56	82	59	33	54	22	11	21	8	3	13
United States average	24	14	13	17	9	8	8	3	4	4	1	2

Increase in Heavy Traffic Loads

Axle loads of loaded vehicles in 1945, taking the whole United States, averaged 10,017 lb. compared to 7,552 in the prewar period. The frequency of the heavier axle loads also increased about five times, the highest frequency being in the Middle Atlantic region and the second highest in the New England area.

In limiting loads to prevent overstressing bridges both the spacing of axles and the actual axle loads should be taken into account in determining the permissible gross load. The so-called gross load formula has been widely used to indicate permissible combinations of axle loads and spacings. The formula referred to is $W = C(L + 40)$ in which W is the total weight of the vehicle in pounds, or the weight of an interior group of axles, and L is the distance in feet between the first and last axle of the vehicle, or of any interior group of axles. C is a measure of the load concentration and it is generally thought that a value of C greater than 750 is excessive. Thus the trend in the frequency of C values above 750 may be used as an index of the trend in the practice of excessive loading.

The number of trucks per 1,000 loaded and empty trucks and combinations with values of C in excess of 750, in the summer of 1945, 1944 and 1942 are shown in the accompanying table. The figure 0 indicates less than 5 per 10,000.[U3]

Reducing Fire Hazards

Fire hazard control work is undertaken in California to protect pasture lands and grain fields, but not cultivated or irrigated land or orchards. It includes killing green grass with a diesel oil spray, followed later by burning; and control of vegetation by discing or blading. The control strip is 6 ft. wide when burned, or the width of one operation if disced or bladed. Blading is the most economical; it is not undertaken between the edge of the traveled way and the gutter.

A new method employs a machine which directs an intense flame over a strip of grass, killing it; the dead grass is burned later. Chemicals have not proved successful, although some new ones show promise.[P2]

Subgrade Moisture Conditions

The load-carrying ability of a soil varies markedly with variations in moisture content; and it is important to be able to estimate what this content will be in the future. In studies made by the Highway Research Board, moisture contents were computed in three different ways—percentage of saturation, percentage of the plastic limit, and percentage of the optimum moisture content. It was found that in embankments which had been covered with pavements for several years the moisture content in the upper 6", expressed in any of the three ways, was generally low for sandy soils and sandy loam, and highest for fine-textured soils such as clay. All soils tended to have moisture content above the optimum. As to the rate at which moisture conditions change beneath a pavement, it was found that soils which were covered when relatively dry tended to become wetter over a period of years. The terminal condition depended on texture of the soil, climate and other factors. There appeared to be a seasonal variation also. Commonly there was more moisture beneath the edges of a pavement and greater fluctuation than in the center.[N7]

Cotton Fabric in Bituminous Construction

In 1926 experiments were begun to test the practicability of using cotton fabric in low-cost bituminous road surfacing, but systematic field tests on experimental roads did not begin until 1936. In these, the road was cleaned, given a priming treatment with liquid asphalt, tar, or emulsion and covered with a fairly open, loosely woven cloth, either along the edges or covering the full width of the road. On this was laid a regular bituminous surface. A laboratory investigation was conducted by the Public Roads Administration at the Arlington Experimental Farm. The average cost of the fabric delivered and placed was 7.35 cents per sq. yd. Reports from state highway departments indicated that there was little difference between the maintenance required for roads with and without the fabric.

The investigation by the P.R.A. shows that "the benefits expected to result from the use of cotton fabric were not obtained. No benefit of fabric as an edge reinforcement was apparent. Edge failures are not as prevalent now as

When you need special information—consult the classified READERS' SERVICE DEPT., *pages 63-65*

formerly and at present they are caused chiefly by unsatisfactory base conditions.

The assumption that the fabric, when impregnated with asphalt or tar, would serve as a waterproof membrane to prevent surface moisture reaching the base did not prove correct as the fabric deteriorated even when surface and base failures did not occur.

Since failures resulting from inadequate base support were as prevalent on sections containing fabric as on those in which fabric was not used, it cannot be said that cotton fabric would compensate for inadequate base support or permit the construction of cheaper bases.

Under certain conditions cotton fabric was beneficial when used on wooden bridge floors.

The use of cotton fabric in the types of construction employed in these experiments results in a material increase in the cost of construction. It has little or no practical value consequently the increased cost is not warranted. When used on bridge floors the increased cost may or may not be warranted depending upon the condition of the structure."[U1]

Equipment Used in Resurfacing

An oil-gravel road-mix road built in Denver under war demands and conditions in 1943 began to ravel and in 1946 about 3.5 miles of it, a 4-lane express roadway 48 ft. wide and two 2-lane service roads, were reconditioned. An area sufficient for one or two days work was scarified to a depth of 3", then disced until thoroughly pulverized, turned over several times while drying, and SC-3 asphalt added, and the mixture worked, bladed out and rolled into a 2" mat, and sealed with 0.25 gal. of RC-4 covered with 20 to 25 lb. of ⅜" chips. In this work the Colorado highway department used 8 graders equipped with heavy scarifier teeth and one with a disc attachment, a tractor-drawn disc harrow, a pneumatic roller, a 3,000 gal. oil truck, 2 boosters, 3 dump trucks, and a front-end vertical loader for cleaning up.[N2]

Laying Integral Street Curb

In laying concrete pavement and integral curb in Dearborn, Mich., the contractor used on the pavement a strike-off machine in which the screed was notched at one end so that it left a windrow of concrete on one side roughly the shape and size of the finished curb, which was a standard rolled curb 6" wide and 5¼" high. The inner side of this machine rode a 6" steel form at the center line and the outer side rode 12" steel road forms which served to back up the finished curb. A following machine carried a cast steel moulding iron and a steel throat which further formed the concrete windrow, leaving a half-finished curb. The curb was finished by hand, using a heavy wood darby, a 6 ft. wood straight-edge and a steel trowel.[N5]

Off-Street Parking Necessary

Expressways planned will increase the seriousness of the parking problem in cities. Street parking has already so inconvenienced users of business districts as to cause property there to decrease in value, such decrease in Baltimore having reduced the annual tax yield by $1,800,000 since 1931. All-day street parking in the congested area should be prohibited. Off-street parking, either municipally or privately operated, seems to be the only answer. Philadelphia has erected a 4-story parking building. In other cities, department stores have converted one or more floors into parking garages. Underground parking is a solution adopted in several cities. San Francisco has a 4-story parking garage beneath Union Square; Detroit will build a 1,000-car subterranean garage 2 stories deep.[N6]

Gritting Roadways

To be most serviceable, spreading grit on roadways should generally be done before morning traffic begins—say before 7:30 A.M. Spreading by machine, as compared with hand spreading, shows (in England) a saving of 67% in time and 12% in material. "Generally speaking, it is enough if the

spread of grit covers two thirds of the total width of the carriage way. The remaining one sixth of each haunch will be quickly covered by grit swept toward the gutters by traffic action." Street cleaners using hand brooms can be used to sweep back into the traffic lanes such grit as is thrown beyond them. They also should grit by hand such danger points as the approach to traffic signals, pedestrian crossings and road junctions and other points where traffic might have to brake quickly, if the gritting machine has not yet reached there. A single application of grit may use 1½ to 3 cu. yd. of grit per mile, and 10 to 20 cu. yd. per mile should be stored in dumps or bins before the freezing season begins.[D2]

Financing Construction Equipment

Instead of bankers, financing companies now provide most of the loans needed by contractors. They finance almost every type of construction equipment, including new, used or surplus machinery up to even 90% of the wholesale cost. They expect about 10% reduction of the outstanding balance every 90 days. The contractor can buy several items from one or more distributors and combine the total into one simultaneous financial transaction. The better equipped finance companies employ a highly trained field staff who call on distributors and contractors at regular intervals and keep their companies informed of conditions in the construction industry; also give contractors suggestions concerning construction methods and hints as to where hard-to-locate equipment might be found.[N8]

Bibliography of Highway and Airport Literature

D *The Surveyor (England)*
November 15

1. Soil Survey Procedure and Its Application to Road Construction. By A. H. D. Markwick. Pp. 887-888.

November 22

2. Speeding Up Gritting Operations. By Thomas Vickers. Pp. 899-900.
3. Sweden's Highway System. Pp. 901-902.

November 29

4. Road and Building Construction on Clay. By Arthur W. Kenyon. Pp. 928-931.

E *Engineering News-Record*
November 28

1. Preventive Maintenance Extends Life of Missouri Highway Equipment Pp. 55-57.
2. Solving the Problem of "Nalyeds" in Permafrost Regions. By A. Tchekotillo. Pp. 62-65.

December 12

3. Moving 178,000 cu. yd. of Earth Monthly for the Shirley Highway. Pp. 96-98.
4. The Birth of Mechanized Construction. By C. S. Hill. Pp. 102-105.
5. Distributed Reinforcement in Pavements Found Advantageous in Rhode Island. By Lee V. Spencer. Pp. 122-123.

L *Civil Engineering*
December

1. Road Cost Must Be Justified by Savings to Drivers. By Jesse E. Williams. Pp. 540-541.

N *Roads and Streets*
October

1. The AAF's Proving Ground Airport. Pp. 65-70.
2. State Maintenance Crew Reworks Oil Mix Surface. Pp. 76-78.
3. Urban Highway and the Interstate System. By Roy E. Jorgensen. Pp. 84-86.
4. Route Planning in Connecticut Cities. By L. T. Scott-Smith. Pp. 86-88.
5. Constructing Integral Street Curb. Pp. 89-90.
6. The Parking Problem and Urban Expressways. By Paul Donald. Pp. 91-92.
7. Subgrade Moisture Conditions. By Miles S. Kersten. Pp. 94, 96, 99.
8. Construction Equipment Financing. By H. K. Glidden. Pp. 100, 102.

O *Roads and Bridges*
November

1. Paving Methods on the Toronto-Oshawa Dual Highway. Pp. 62-65, 122.
2. Regina and Stratford Have 30-year Program of Civic Development. By E. G. Faludi. Pp. 66-69, 108.
3. Winter Maintenance Practice on Ontario Highways. Pp. 70-72, 120.
4. Trends in Highway Accidents. By Geo. H. Gallup. Pp. 73, 101.
5. Soil Stabilization Principles. By L. N. McManus. Pp. 74, 104.
6. A Study of Coarse-Graded Base Course Material. By Edward A. Willis. Pp. 75-76, 94.

P *Public Works*
December

1. Ditch Retards to Prevent Erosion. By G. B. Finley. Pp. 19-20, 35.
2. How to Reduce Fire Hazards Along Highways. By E. S. Whitaker and H. N. Bosworth. Pp. 25-26.

U *Public Roads*
Oct.-Nov.-Dec.

1. Cotton Fabric in Bituminous Construction. By Paul F. Critz. Pp. 251-260.
2. Trends in Motor Vehicle Travel, 1936 to 1945. By G. P. St. Clair. Pp. 261-267.
3. Traffic Trends on Rural Roads in 1945. By Thomas B. Dimmick. Pp. 268-274.

Y *Contractors' Record (England)*
December 4

1. British Road Federation Report on Swedish Roads. Pp. 19-22.

DIRECTORY OF CONSULTING ENGINEERS

ALBRIGHT & FRIEL, Inc.
Consulting Engineers
WATER, SEWAGE & INDUSTRIAL WASTE PROBLEMS, AIRFIELDS, REFUSE INCINERATORS & POWER PLANTS
INDUSTRIAL BUILDINGS
CITY PLANNING — REPORTS
VALUATIONS — LABORATORY
1520 Locust Street — Philadelphia 2

JAMES M. CAIRD
Assoc. Am. Soc. C. E.
Chemist and Bacteriologist
Water Analysts and Tests of Filter Plants
Office and Laboratory
Cannon Bldg., Broadway & 2nd St.
Troy, N. Y.

J. W. GOODWIN ENGINEERING CO.
Municipal and Consulting Engineers
Design and Construction Supervision
Air Ports, Waterworks, Sewerage, Sewage Treatment, Water Treatment, Gas Systems, Street Improvements, Reports, Appraisals
Birmingham, Alabama

Charles B. Burdick — Louis R. Howson
Donald H. Maxwell
ALVORD, BURDICK & HOWSON
Engineers
Water Works, Water Purification, Flood Relief, Sewerage, Sewage Disposal, Drainage, Appraisals, Power Generation
Civic Opera Building — Chicago

THE CHESTER ENGINEERS
Water Supply and Purification
Sewerage and Sewage Treatment
Power Developments and Applications
Investigations and Reports
Valuations and Rates
210 E. Park Way at Sandusky
Pittsburgh 12, Pa.

GREELEY AND HANSEN
Engineers
Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal
220 S. State Street, Chicago 4
180 Broadway, New York 7

BANISTER ENGINEERING CO.
Consulting Engineers
POWER PLANTS, WATERWORKS, CITY PLANNING, RURAL ELECTRIFICATION, SANITATION, WASTE PROBLEMS, AIRPORTS, STREET IMPROVEMENTS
1549 University Ave.
St. Paul 4, Minn.

CHAS. W. COLE & SON
Consulting Engineers
Sewerage, Sewage Treatment, Industrial Wastes, Water Supply, Water Treatment, Airports, Industrial Buildings
Design and Supervision
Chas. W. Cole, Sr. — Chas. W. Cole, Jr.
Ralph J. Bushee — M. J. McErlain
Wilbur H. Gartner
220 W. LaSalle — South Bend, Ind.

HOWARD R. GREEN CO.
Consulting Engineers
DESIGN AND SUPERVISION OF MUNICIPAL DEVELOPMENTS
Water Works and Treatment—Sewers and Sewage Disposal—Investigations and Valuations
208-10 Bever Bldg., Cedar Rapids, Iowa
Established 1913

BARKER & WHEELER
Engineers
Water Supply, Sewerage, Sewage Disposal, Power, Public Utility and Industrial Valuations and Rates
36 State Street, Albany 7, N. Y.
11 Park Place, New York City 7

CONSOER, TOWNSEND & ASSOCIATES
Water Supply—Sewerage—Flood Control & Drainage — Bridges—Express Highways — Paving—Power Plants—Appraisals—Reports —Traffic Studies—Airports
Times Bldg., 211 W. Wacker Dr.
Chicago 6, Ill.

JOHN J. HARTE CO.
Engineers
Waterworks, Sewerage, Treatment Plants, Gas Systems, Street and Storm Drainage, Improvements, Public Buildings, Airports.
ATLANTA, GEORGIA

BLACK & VEATCH
Consulting Engineers
Sewerage, Sewage Disposal, Water Supply, Water Purification, Electric Lighting, Power Plants, Valuations, Special Investigations, Reports and Laboratory Service
E. B. Black — N. T. Veatch
A. P. Learned — H. F. Lutz
F. M. Veatch — J. F. Brown
E. L. Filby
4706 Broadway — Kansas City, Missouri

A. W. DOW, Inc.
Chemical Engineers
Consulting Paving Engineers
Mem. Am. Insti. Ch. Engrs.
Asphalt, Bitumens, Tars, Waterproofing, Paving, Engineering, Materials
801 Second Avenue — New York

HILL & HILL
Engineers
Sewage and Waste Disposal, Water Supply and Filtration, Dams, Reservoirs, Tunnels, Airport and Topographic Surveys
Home Office: 24 E. Main St., North East, Pa.

BOGERT-CHILDS ENGINEERING ASSOCIATES
Consulting Engineers
Clinton L. Bogert — John M. M. Greig
Howard J. Carlock — Fred S. Childs
Water Supply and Purification, Sewerage and Sewage Treatment, Flood Control and Drainage, Refuse Disposal
City Planning—Investigations—Reports
624 Madison Avenue — New York 22, N. Y.

GANNETT FLEMING CORDDRY & CARPENTER, INC.
Engineers
Water Works, Sewage, Industrial Wastes & Garbage Disposal
Roads, Airports, Bridges & Flood Control
Town Planning, Appraisals, Investigations & Reports
Harrisburg, Pa. — New York, N. Y.

WM. S. LOZIER CO.
Consulting Engineers
Sewerage, Sewage Disposal, Water Supply, Water Purification, Refuse Disposal
10 Gibbs Street — Rochester 4, N. Y.

BOWE, ALBERTSON & ASSOCIATES
Engineers
Sewerage—Sewage Treatment
Water Supply—Purification
Refuse Disposal—Analyses
Municipal—Industrial Projects
Valuations—Reports—Designs
110 William Street — New York 7, N. Y.

WILLIAM A. GOFF
Consulting Engineer
Private and Municipal Engineering
Sewerage, Sewage Disposal
Water Supply and Treatment
Garbage, Refuse, Industrial Wastes
Design, Supervision, Valuations, Reports
Broad St. Station Bldg. — Philadelphia

METCALF & EDDY
Engineers
Water, Sewage, Drainage, Refuse and Industrial Wastes Problems
Airfields — Valuations
Laboratory
Statler Building — Boston 16

BUCK, SEIFERT AND JOST
Consulting Engineers
(FORMERLY NICHOLAS S. HILL ASSOCIATES)
Water Supply — Sewage Disposal
Hydraulic Developments
Reports, Investigations, Valuations
Rates, Design, Construction, Operation Management, Chemical and Biological Laboratories
112 East 19th St. — New York City

MICHAEL BAKER, JR.
The Baker Engineers
CIVIL ENGINEERS—PLANNERS—SURVEYORS—MUNICIPAL ENGINEERS
Airport Design • Sewage Disposal Systems • Water Works Design & Operation
Consulting Services • Surveys and Maps
HOME OFFICE — ROCHESTER, PA.
Jackson—Omaha—Philadelphia—Pittsburgh—Harrisburg—Atlanta—Anchorage, Alaska

BURRILL AND GWIN
Engineers
Water Supply and Purification
Electric Power and Heating Plants
Sewage Disposal and Sewerage Systems
Mining and Industrial Plant Design
Altoona, Pa. — Baltimore, Md.

ROBERT AND COMPANY
INCORPORATED
Architects and Engineers
WASHINGTON — ATLANTA — NEW YORK
WATER SUPPLY • SEWAGE DISPOSAL • INCINERATORS • POWER PLANTS

Book Reviews

The Effects of Atomic Bombs on Hiroshima and Nagasaki. The United States Strategic Bombing Survey. U.S. Government Printing Office, Washington, D. C. June, 1946. 46 pp., illus., tables, maps. 45¢.

Brick and wood frame buildings in Japan reacted to the bomb much as typical American structures would have—they were exceedingly vulnerable. Modern reinforced concrete and steel frame buildings would fare better here, as they did in Japan. The overwhelming bulk of our buildings could not stand up against an atomic bomb bursting a mile or a mile and a half from them. The casualty rate must not be too readily discounted because of the teeming populations of congested Japanese cities. American cities too have their crowded slums, and in addition tend to build vertically so that the density of population is high in a given area even though each apartment dweller may have more living space than his Japanese equivalent.

In our planning for the future, if we are realistic, we will prepare to minimize the destructiveness of any such attacks and so organize the economic and administrative life of the nation that no single or small group of successful attacks can paralyze the national organism. If a policy is laid down well in advance of any crisis it will enable timely decentralization of industrial and medical facilities, construction or blueprinting of shelters, and preparation for life-saving evacuation programs.

Reviewed by: The Bureau of Urban Research.

New City Patterns. By S. E. Sanders, Director, City Planning Research, Federal Works Agency, and A. J. Rabuck, City Planning Research, P.B.A. Reinhold Publishing Corp., New York. 1946. 197 pp., illus., diagrams, tables. $8.00.

The purpose of this book is to illustrate the need for and a method of developing new city patterns based on planning objectives resulting in functional arrangements of land uses so flexible as to accommodate new and advanced techniques and inventions as they may be developed. These patterns are based on an analysis of the causes and effects of slums, blight, congestion and general urban inefficiency. The authors show that all levels of government are concerned with the planning of metropolitan areas and suggest a method of cooperation. The authors also suggest a means of financing and programming the execution of such new city patterns through the cooperation of all levels of government and private enterprise.

One of the chapters demonstrates the general application of planning objectives and principles to a large urban area. Consideration is directed first to the broad over-all plan of transportation and land use, and then to the redevelopment plan for the portion of a specific central blighted and slum area. The details of subcommunity and neighborhood unit planning and design are worked out and adjusted so as to harmonize in all respects with the master plan for the whole urban area.

Reviewed by: The Bureau of Urban Research.

Clay Pipe Engineering Manual. Published by Clay Sewer Pipe Association, Inc., 1105 Huntington Bank Bldg., Columbus 15, O. 159 pp., illustrated. $3.

This book, recently prepared under the direction of Benjamin Eisner, provides engineering reference data applicable to the design and construction of sanitary sewer systems; storm water drainage; and subsoil, roadway, airport and railroad drainage. It is a good book because it is written in clear and simple language; it takes the reader by easy steps through such complicated matters as estimating future sanitary sewage flow, the hydraulics of sewers, sewer and drain layout, pipe strength and trench loading, and pipe laying. Examples of design are worked out step-by-step. There are excellent flow and discharge charts. ASTM specifications C 13-44T for standard strength clay sewer pipe and C 200-44T for extra strength clay pipe are given; also tables of dimensions for each. Additional similar design information is given for house sewers, storm sewers and road and airport drains. We recommend this book.—Reviewed by W. A. Hardenbergh.

Pump Engineering Data. Published by Economy Pumps, Inc., Hamilton, O. 416 pp., numerous illustrations. $2.

This is the fourth edition of this very useful and handy book, which contains so much data that a complete review here is impossible. The first 42 pages are devoted to the "principles of pump engineering," and include such data as (a) how a centrifugal pump operates; (b) determination of total dynamic head; (c) horsepower required; (d) testing centrifugal pumps; (e) velocity head; (f) suction lifts; (g) installation; and (h) operation. A total of 107 pages are devoted to engineering data, including (a) flow of water in pipes and fittings; (b) measurement of flow; (c) hydraulic data; (d) corrosion resistance; (e) pipe and fitting dimensions; (f) operating efficiencies and costs; (g) pump application and sizing; (h) a lot of miscellaneous pump and hydraulic data; and (i) conversion factors. The remainder of the text is devoted to descriptions, uses and installation data on the various types of pumps. An excellent handbook.—Reviewed by W. A. Hardenbergh.

PUBLIC WORKS Equipment News

P&H Single-Pass Soil Stabilizer

A new illustrated bulletin has been published by Harnischfeger Corporation describing the new P&H single pass soil stabilizer. Designed to make use of on-the-spot materials in building subgrades, secondary roads, airports, etc., the machine draws its name from its stated ability to perform all stabilizing operations in a single pass. These operations include shaving and pulverizing the in-place material; thorough blending; application of liquids; final mixing; and spreading to a uniform depth. Write Harnischfeger Corporation, Milwaukee 14, Wisc., for the Soil Stabilizer Bulletin.

P&H Soil Stabilizer.

Nickel-Base Corrosion-Resisting Alloys

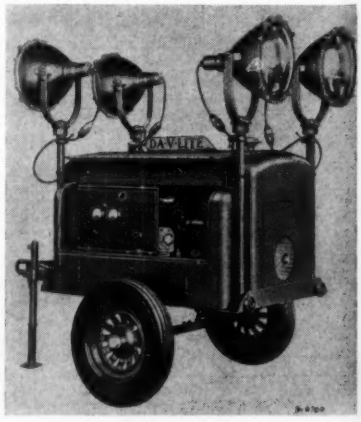
Two new corrosion-resistant metals have been developed by Duriron Co., Dayton, O. Chlorimet No. 2 is primarily nickel and molybdenum; it is resistant to hydrochloric acid in all concentrations and temperatures, and also gives excellent service in 35% to 60% sulfuric acid service, up to boiling, or stronger acid at lower temperatures. It also handles wet hydrogen chloride gas. Chlorimet No. 3 is a combination of nickel, chromium and molybdenum; it has excellent mechanical properties and unusual resistance to most acids—hot sulfuric up to 35% and 176°F, and ammonium, sodium, zinc and nickel chlorides, and hypochlorite bleaches, at not over 105°F. These metals are available for engineered equipment such as pumps and valves. Complete information is available from the manufacturer.

Caterpillar 212 Diesel Motor Grader

With the resumption of production of the "Caterpillar" Diesel No. 212 Motor Grader, the manufacturer has published an illustrated folder outlining the construction attributes and operational advantages of this machine. These include basic specification figures, tandem or single drive, leaning front wheels, variety of blade positions offered, extreme positions possible by adjustment, and the attachments available to users. Copies of the folder may be obtained from Caterpillar Tractor Co., Peoria 8, Illinois, requesting Form 9730. *(Add to Chapter 6, Highway, Street and Airport Manual)*

Portable Lighting and Power Units

Four new portable lighting and power units have just been announced by Davey Compressor Co., Kent, Ohio. These are built around a 5000-watt Westinghouse self-excited, self-regulated



Davey Lighting and Power Unit.

A-C generator, driven by a 15 h.p., 4 cylinder Wisconsin air-cooled engine, equipped with electric starter.

The four standard models, as announced, are (1) floodlight, (2) searchlight, (3) combination, (4) beacon. All are available in skid and 2-wheel spring trailer mountings. Trailer machines are 9′ long, 7′6″ high and 5′ wide. Weight is approximately 1750 lbs.

In addition to their lighting uses, all four models can be employed in case of emergency, to supplement existing pow-

Ford 1½ ton trucks, with Gar Wood load-packer bodies are used for collecting garbage in Dearborn, Mich. Special Trucksteel equipment permits loading these trucks to 10 tons. This is one of 12 new trucks.

Snow removal and use of rock salt keeps highways open.

er facilities or to provide motive power for electric tools. *(Add to Chap. 6, Highway, Street and Airport Manual.)*

Clay Pipe French Drains

Clap pipe, with bells ends up-grade, and embedded in gravel or broken stone, are recommended by the Clay Sewer Pipe Association for airport installations. The drains are located along the edges of runways, in fields where water levels must be reduced, in parking areas

Akron-Canton-Massillon, Ohio, airport, which is well drained.

and around terminal and hangar foundations. The Akron-Canton-Massillon Airport, shown herewith, utilizes this type of drainage.

McCulloch Gasoline Engines

A new type of light-weight industrial gasoline engine is now being mass-produced by McCulloch Motors Corporation, 6101 W. Century Blvd., Los Angeles 45, California. This is the first model of a series of industrial engines to be built by this firm.

McCulloch light-weight engine.

The engine illustrated, Model 1200D, is a single-cylinder, 2-cycle, air-cooled type that weighs only 24 pounds, yet develops a rated 2.5 hp at 2500 rpm. It has extreme light weight, small size, simplicity and fast acceleration. In addition, the McCulloch engine has features not always associated with 2-cycle engines, such as easy starting and smooth idling.

A General Utility Truck Loading Device

A practical loader and scoop for attachment to trucks is available from the Truk-Loder Co., Tiffin, Ohio. The bucket is half-yard for general work, but a 1.1-yd. bucket is available for snow and leaves. This loader can be used for scraping or scooping; and can load trucks from either the side or rear. It can be used on clean-up jobs, handling refuse, brick, cement, etc. It is fast and economical on leaf loading and on snow removal. It can be used as a platform for trimming trees, and as a gin-pole for handling pipe. The placement or removal is a matter of handling two 1-inch bolts.

Revere Gas Engine Driven Generator

A newly developed power unit manufactured by Revere Electric Mfg. Co., 6009 Broadway, Chicago, Ill., can be used by day, for the operation of electric saws, drills, etc., by merely plugging them in at the control panel; and for night work illumination. The unit is equipped with an air cooled engine that won't overheat in summer or freeze in winter; it stops and starts by means of push buttons on the control panel. One, two or three yoke type floodlights can be accommodated with a total capacity of 3000 watts.

Pump Valve Replacement Service

Materials shortages and transportation complicate procurement of much new equipment, but old pumps can be rehabilitated or adapted to new types of service by fitting Durabla valves. Catalog 920, "Pump Valve Service," which can be obtained from Durabla Mfg. Co., 114 Liberty St., New York 6, N. Y., provides a summary of the design characteristics of Durabla valves and indicates their adaptability for use as replacement units on any type of reciprocating pumps.

Pumps and Controls

Pumps, Power and Compressors.—Centrifugal pumps, single and two-stage volute for boiler circulation and heater drain service; oil, gas, or dual fuel diesel engines, 36 pages; package type, steam turbine generator power plant, 500, 1000 and 2000 kw; and single stage horizontal compressors. For copies, write Worthington Pump and Machinery Corp., Harrison, N. J.

Pumps.—Economy Pumps, Inc., Hamilton, O., has issued a new bulletin—D-246 covering their line of SCV, vertical centrifugal, pumps. These pumps require less floor space and are easier to clean.

Two-Stage Centrifugal Pumps.—Ingersoll-Rand Co., Phillipsburg, N. J., has published a 16-page catalog on 2-stage centrifugals designed to operate at modern motor, turbine and engine speeds, up to 2200 gpm. and 1050-ft. heads.

Automatic Controls.—A number of descriptive sheets and installation drawings bound in a folder; describes liquid level controls, with no moving parts, time switches, audible signals, etc. Lumenite Electronic Co., 407 South Dearborn St., Chicago 5, Ill.

Controller.—The Model 40 controller is described in Bulletin 381, issued by the Foxboro Co., Foxboro, Mass. Five types of control action are described.

Road Research Program at Wisconsin College of Engineering

A five-year research project to promote safe, economic and efficient highway transportation has entered its initial phase during the current school year at the University of Wisconsin College of Engineering. The project, supported by a grant accepted in 1945 from the Four Wheel Drive Auto Company, is under the direction of Archie H. Easton, who recently joined the university staff in order to take charge of the project. He was on the staff at the Aberdeen Military Proving Grounds for the past five years, and prior to that time, was employed in the research department of the United States Bureau of Standards.

At a meeting between university representatives and FWD officials before the opening of the fall school session, an outline for the research project, including the objectives and the scope of study, was considered. Those from the university who met with the FWD officials were Dean M. O. Withey, College of Engineering; Frank O. Holt, director of the Public Service Department; Mr. Easton, and the Project Committee consisting of Lloyd F. Rader, chairman; Professor Patrick H. Hyland and Professor Kurt F. Wendt.

The primary objectives of the research project are to make basic studies of truck and highway design considering safety, economy and efficiency, to compare four-wheel drive trucks with single-axle drive trucks through experimental tests; to provide advanced study in the fundamentals and techniques of truck and highway design for safe, economic and efficient transportation and to make other miscellaneous studies.

Asphalt Institute

The board of directors of The Asphalt Institute, representing the major part of the petroleum asphalt production industry of the United States and Canada, has elected C. Wayne Barbour of Allied Materials Corporation, Oklahoma City, Okla., president and chairman of the Executive Committee, with George R. Christie, Socony-Vacuum Oil Company, Inc.; Inghram Grayson, Lion Oil Company; Raymond Harsch, Shell Oil Company, Inc., San Francisco, Calif.; James J. Kelly, Kerr-McGee Oil Industries, Inc., Fen-Ter Refining Division; D. N. Myers, Byerlyte Corporation; and J. S. Sawyer, Shell Oil Company, Inc., New York, N. Y., completing the committee.

The five vice-presidents elected with their respective divisional jurisdiction, were as follows: Division I: Atlantic-Gulf, J. S. Sawyer; Division II: Ohio-Great Lakes, D. N. Myers; Division III: Mid-West, Inghram Grayson; Division IV: Southwest, James J. Kelly; Division V: Pacific Coast, Raymond Harsch.

Bernard E. Gray was re-elected general manager-chief engineer and Herbert Spencer, secretary of the Institute. F. V. Widger, Witco Chemical Company, was elected treasurer and John N. Smith, Socony-Vacuum Oil Company, Inc., assistant treasurer.

Association Meetings

New Jersey Sewage Works.—The 32nd annual meeting of the New Jersey Sewage Works Assn., will be held at the Stacy-Trent Hotel, Trenton, N. J., March 19-21. M. S. Kachorsky, Box 283, Manville, N. J., is secretary.

An On-the-Job Training Program for Your Highway Personnel

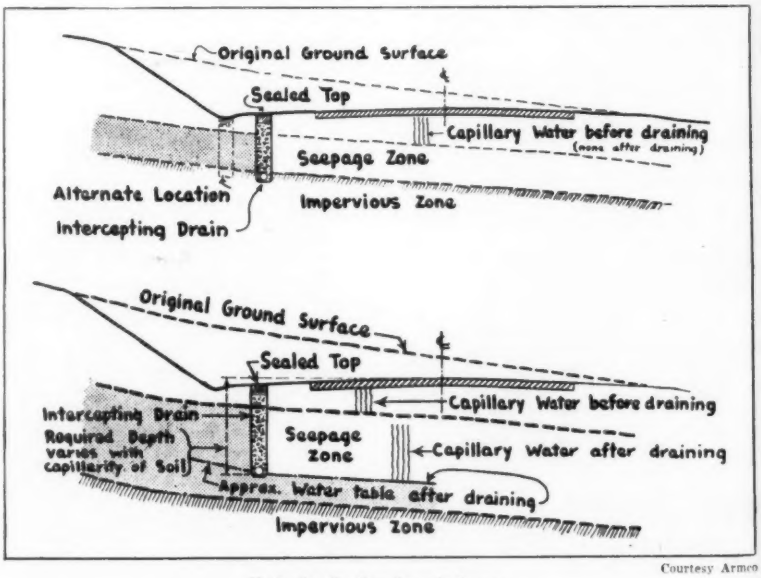
(Continued from page 32)

the water is discharged to a free outlet. A variation of this problem occurs when water enters under the road, normally at or near the high point of a cut, and flows under the road to emerge at some other point. In such cases, a drain may be placed under the road to intercept the water and convey it to a point of discharge.

The other phase of controlling ground water occurs in level areas where the ground water is high and there is normally no (or a very small) movement of the water through the soil. If a free discharge point is available, subdrains are placed at the depth necessary to lower the ground water level enough to prevent rise of capillary water. If there is no free discharge point available, underdrains are useless and the roadbed must be raised, with a porous layer of soil beneath it to prevent the rise of capillary water.

Instruction Aids.—Show charts or slides of typical free and capillary water conditions, various types of drains, and demonstrate use of the soil auger. *References:* Bruce, Chap. 5; Highway Manual, Chapter 1; Armco, various special publications.

[Ed. Note: Sections VII, VIII and IX will be published in the February issue.]



Courtesy Armco

Methods of subsurface drainage.

FOR THE ENGINEERS' LIBRARY

These helpful booklets are free to those actively engaged in Engineering or construction. Mail coupon or write direct to addresses given, mentioning PUBLIC WORKS Magazine.

PW 1-47

Readers' Service Dept., PUBLIC WORKS Magazine
310 East 45th St., New York 17, N. Y.

Please send me without obligation the following booklets listed in your Readers' Service Department.

_____

_____

_____

(Indicate by numbers)

Name_____

Occupation_____

Street_____

City_____

State_____

USE THIS COUPON

CONSTRUCTION MATERIALS AND EQUIPMENT

How to Use Less Labor in Resurfacing

15. You can mechanize your resurfacing with these Portable Bituminous Mixers. 6 to 14 ft. sizes for resurfacing and maintenance. Helpful booklet issued by The Jaeger Machine Co., 400 Dublin Avenue, Columbus 16, Ohio.

Solve Your Drainage Problems This Easy, Permanent Way

70. Standard corruguated pipe, perforated pipe and MULTI-PLATE pipe and arches — for culverts, sewers, subdrains, cattlepasses and other uses. 48-page booklet, No. 12. Armco Drainage and Metal Products, Inc., Dept. PW., Middletown, Ohio.

Improve Appearance of Curbs, Gutters, Sidewalks

78. Curb and Gutter and Sidewalk Forms, including battered face curb form especially for modern traffic conditions. Last 20 years or more. Send for new engineering data Bulletin A-20-F, Dept. P.W., Heltzel Steel Form & Iron Co., Warren, O.

Handle All Kinds of Tough Grading Jobs Economically

98. The Austin-Western 99M Power Grader with its powerful all wheel drive handles difficult jobs with economy and efficiency; and does better work on grading, ditching, scarifying, snow ploughing, loading, mixing, bulldozing, shoulder trenching and backsloping. Write for Bulletin 1946. Dept. P.W., Austin-Western Co., Aurora, Ill.

Reliable Pumps for Every Purpose

117. New brochure by Gorman-Rupp Co., Mansfield, Ohio, illustrates and describes many of the pumps in their complete line. Covers heavy duty and standard duty self-priming centrifugals, jetting pumps, well point pumps, triplex road pumps and the lightweight pumps.

Small Diesel Engines Have Many Municipal Uses

393. Small Diesel engines — down to 3¾ HP. The only stationary Diesel that is air-cooled. For full details on this revolutionary engine for municipal service write R. H. Sheppard Co., 50 Middle St., Hanover, Pa.

Need Street, Sewer or Water Castings?

429. Street, sewer and water castings in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog P.W. issued by South Bend Foundry Co., Lafayette Boul. and Indiana Ave., South Bend 23, Ind.

SNOW FIGHTING

For High-Speed Snow Removal

350. "Frink One-Way Sno-Plows" is a four page catalog illustrating and describing 5 models of One-Way Blade Type Sno-Plows for motor trucks from 1½ up to 8 tons capacity. Interchangeable with V Sno-Plow. Frink Sno-Plows, Inc., Clayton, 1000 Islands, N. Y.

End Dangerous Ice Hazards

354. Ice Prevention on Highways, Streets, and Airport Runways with Sterling "Auger Action" Rock Salt. Illustrated bulletin P.W. issued by International Salt Co., Inc., Scranton, Pa.

Fast, Efficient Skid-Proofing

355. Get full facts about Baughman Light-Weight Cinder Spreaders, fast operators for cinders, sand, salt, chips, etc. Free flowing at low temperatures. 9-17 cu. yd. cap. Write Dept. P.W., Baughman Mfg. Co., Inc., Jerseyville, Ill.

Want to Get Rid Of Snow?

401. Bulletin "Haiss Snow Loaders" tells in 12 illustrated pages how to do fast economical loading in removing snow from streets, highways, etc. Address, George Haiss Mfg. Co., 391 Canal Place, New York, N. Y.

STREETS AND HIGHWAYS

Expansion Joint Fillers for Highways, Dams, Bridges, Etc.

102. Kork-Pak fiber joint, Premoulded Asphalt Joint, Non-Extruding Cork Joint, Self Expanding Joint for use on Highways, Dams, Bridges, Tunnels and General Construction. Bulletin describing and illustrating these joints sent on request to Servicised Products Corp., 6051 West 65th St., Chicago 38, Ill.

Levels Sidewalks and Curbs Quickly and Easily

107. How the Mud-Jack Method for raising concrete curb, gutter, walls and streets solves problems of that kind quickly and economically without the usual cost of time-consuming reconstruction activities—a new bulletin by Koehring Company, 3026 West Concordia Ave., Milwaukee 10, Wis.

Got an Earth Moving Problem?

126. Write Gar Wood Industries, Dept. P.W., Wayne, Mich., on their Two and Four Wheel Scrapers, Bulldozers, Tamping Rollers, Winches, Hoists and Repair Towers.

Speed Your Work With These Powerful Motor Graders

128. Two powerful Galion motor graders designed to answer every requirement for more speed in road, airport, dam and housing construction work are fully described in a folder illustrated with many action pictures. Issued by Galion Iron Works & Mfg. Co., Galion, Ohio.

Tandem, 3 Wheel and 3 Axle Road Rollers

138. "The Buffalo-Springfield" line of road rollers (tandem, 3-wheel, and 3-axle) are described in the latest catalog P.W. issued by the Buffalo-Springfield Roller Co., Springfield, Ohio.

Here's a Roller for Every Need

141. Three-Wheel and Tandem Rollers, 5 to 8-ton and 10 & 12 ton sizes: also variable weight tandem roller for new highway surfacing and old road conditioning. Ask for new bulletin. Dept. P.W., Huber Mfg. Co., Marion, Ohio.

Looking Into Soil Stabilization?

154. "Soil Stabilization with Tarvia" —An illustrated booklet describing the steps in the stabilization of roadway soil with Tarvia will be mailed on request by Dept. P.W., The Barrett Division, 40 Rector St., New York 6, N. Y.

Mix-in Place Roadbuilders Save on Scarce Labor

187. Mix-in Place Roadbuilders. Bituminous Pavers, Concrete Bituminous Finishers. Adjustable Spreaders, Forms, etc. —4 complete catalogs in one cover, issued by the Jaeger Machine Company, 400 Dublin Ave., Columbus 16, Ohio.

Here's Your Diesel Tractor!

190. Big 48 page catalog describes and lists many uses for International Diesel Tractors. Write International Harvester Co., Dept. P.W., 180 North Michigan Ave., Chicago 1, Ill.

Latest Maintenance Equipment For Blacktop Roads

290. "Blacktop Road Maintenance and Construction Equipment" — Asphalt and tar kettles, flue type kettles, spray attachments, tool heaters, surface heaters, road brooms and rollers. This is modern and up-to-date equipment for blacktop airport and road construction and maintenance. Write for Catalog R. Littleford Bros., Inc., 452 East Pearl St., Cincinnati 2, Ohio.

Mow Clean and Fast In Tight Corners

510. Send for latest literature about the Cunningham Mower for Fence Rows, Parking Areas, Driveways, Picnic Grounds and many other jobs. 3 ft. cut, variable speed, rugged, easy to handle. James Cunningham, Son & Co., Dept. 16, 13 Canal St., Rochester 8, N. Y.

All Purpose Spreader Spreads 2 to 10 ft. Wide

514. Saves labor, spreads 0 to 100 lbs. a sq. yd., dust up to 1" material, forward, reverse, on curves, hills or straightaway. Assures uniform, even density of spread. Write for bulletin: Dept. PW, All Purpose Spreader Co., Fuller Rd., Elyria, Ohio.

SEWAGE DISPOSAL

Non-Corrosive, Long Lasting Low Cost of Sewer Pipe

72. Get this new engineering data on clay pipe for sewers. Withstands acid, alkali and gas attacks indefinitely. Cuts maintenance costs to a minimum. Write Dept. P.W., National Clay Pipe Mfrs., 111 W. Washington St., Chicago 2, Ill.

Does Air Sabotage Your Pipe Lines and Pumps?

357. Automatic Air Release Valves for water, sewage and industrial uses automatically vent air accumulations. Ask for latest illustrated engineering bulletins. Simpex Valve & Meter Co., 6750 Upland St., Philadelphia 42, Pa.

Valuable Booklet on Porous Diffuser Plates and Tubes

367. A valuable booklet on porous diffuser plates and tubes for sewage treatment plants. Covers permeability, porosity, pore size and pressure loss data, with curves. Also information on installations, with sketches and pictures, specifications, methods of cleaning and studies in permeability, 20 pp. illustrated. Write to Norton Company, Dept. P.W., Worcester 6, Mass.

How Cities Can Do Complete Sewer Cleaning From Street

387. Literature illustrating how cities, towns and villages using OK Champion Sewer Cleaners are doing a complete sewer cleaning job from street level. Three sizes of machines available in addition to full line of sewer rods and accessories. Issued by Champion Corporation, 4752 Sheffield Avenue, Hammond, Indiana.

How to Combat Corrosion In Your Gas Holder

412. A 16-page bulletin gives detailed information on the development of corrosion—and how to combat it—in gas holders. A copy will be mailed on request to The Stacey Bros. Gas Construction Company, 5535 Vine St., Cincinnati 16, Ohio.

Diesel Generators That Use "No Cost" Sewage Gas

420. Le Roi engine-generator units for operating on "no cost" sewage gas are fully described and illustrated in new bulletins now available. Address Le Roi Co., 1770 S. 68th St., Milwaukee 14, Wis.

How to Select Main Line Meters

432. New bulletin illustrates Builders Air Relay system for liquids containing suspended solids like sewage. Eliminates corrosion, clogged pipes, etc. "The Selection of Main Line Meters," a highly informative and useful presentation, describes forms of differential producers and quickly solves typical problems with the use of graphic charts. Write Builders-Providence, Inc., Dept. P.W., 9 Codding St., Providence 1, R. I.

How to Make Better Sewer Pipe Joints

447. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston, Dept. P.W., Adams, Mass.

Incineration From the Commonsense Standpoint

462. "Disposal of Community Refuse by Incineration" is a handsome 34-page booklet that discusses incineration from a commonsense standpoint. Illustrated by numerous photos of typical installations and includes diagrammatic outlines of various plant designs. Write Morse Boulger Destructor Co., 207-P East 42nd St., New York 17, N. Y.

An Incinerator Necessity

463. Recuperator tubes made from Silicon Carbide and "Fireclay" Corebusters for maximum efficiency are described and illustrated in bulletin No. 11 issued by Fitch Recuperator Co., Dept. P.W., Plainfield National Bank Bldg., Plainfield, N. J.

Ask for This Design Data On Sprinkling Filters

469. Design data on sprinkling filters of Separate Nozzle Field and Common Nozzle Field design as well as complete data on single and twin dosing tanks, and the various siphons used in them, for apportioning sewage to nozzles. Many time-saving charts and tables. Write Pacific Flush Tank Co., Dept. P.W., 4241 Ravenswood Ave., Chicago 13, Ill.

Design Details for Sludge Collectors

480. Booklet No. P.W. 1642 on Link-Belt Circuline Collectors contains sanitary engineering data and design details. Catalog No. 1742 on Straightline Collectors, contains layout drawings, installation pictures and capacity tables. Address Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia 40, Pa.

Packaged Sewage Treatment—Just Right for Small Places

488. "Packaged" Sewage Treatment Plants specifically developed for small communities — 100 to 3,000 population. Write for full description and actual operating data for this type of plant. Chicago Pump Co., 2348 Wolfram St., Chicago 18, Ill.

Look Into This Sewage Treatment Equipment

490. New bulletin P.W. fully describes and illustrates Hardinge sludge collectors for clarifiers, sludge concentration and skimming in both circular and rectangular tanks. Write Dept. P.W., Hardinge Company, Inc., York, Pa.

Glazed Clay Blocks for Trickling Filter Underdrains

492. Illustrated bulletin describes the Natco Unifilter block of glazed, hard burned clay for underdraining filter beds. Write National fireproofing Corp., Pittsburg 12, Pa., for free copy.

For All Sludge Dewatering

601. The first filters to be used in large scale operation on primary, elutriated and Guggenheim sludges. Ask for latest engineering Bulletin P.W. General American Process Equipment Div., 10 E. 49th St., New York, N. Y.

Low Cost Air for Sewage Disposal

602. All interested in low cost air for sewage disposal will want a copy of this useful booklet. Describes operating principles and specifications of Roots-Connersville Aerating Blowers. Write to Roots-Connersville Blower Corp., 301 Valley Ave., Connersville, Ind.

WATER WORKS

How to Analyze Water

360. "Methods of Analyzing Water for Municipal and Industrial Use" is an excellent 94 page booklet with many useful tables and formulas. Sent on request by Solvay Sales Corp., Dept. P.W., 40 Rector St., New York 6, N. Y.

Do Your Water Mains Need Cleaning?

388. Literature on Flexible method of cleaning water mains any size from 2" to 72", giving full details and list of nearest representatives in all parts of country. Address: Flexible Underground Pipe Cleaning Co., 9059 Venice Blvd., Los Angeles, Calif.

For All Water Tank Maintenance Troubles

389. For all water tank maintenance troubles, whether the need is for repairs, painting, welding, or cleaning, get latest literature of Chicago Tank and Bridge Co., 618 Empire Bldg., Rockford, Ill.

Solve Corrosion Problems With This Special Alloy

391. "Everdur Metal" is title of an 8-page illustrated booklet describing advantages of this corrosion-resisting alloy for sewage treatment equipment, reservoir, and waterworks service. Dept. P.W., the American Brass Co., 25 Broadway, N. Y. C.

To Measure, Mix, Feed Chlorine or Other Gases

397. Everson SterElators. Bulletins 1063, 1066, 708 and others describe this device for measuring, mixing and feeding

USE COUPON ON PAGE 63

chlorine or other gases in solution. Capacities range from ¼ lb. to 2,000 lb. of gas per 24 hours. Address: Everson Manufacturing Co., 214 W. Huron St., Chicago 10, Ill.

Get These Facts About New Vari-I-Feeder

398. There is a new 16-page illustrated booklet on accurate chemical feeding, describing the Var-I-Feeder, which every waterworks, sewage works and swimming pool man will want a copy of. For yours, just address: Chemical Feeders Division, Morse Boulger Destructor Co., 205P East 42nd St., New York 17.

Make Water Extra Safe

399. Safe water may be one of the civic improvements your citizens expect soon. Feeders of all types including Hypochlorinators, Reagent Feeders, Dry Chemical Feeders, Chlorinators and Ammoniators for feeding all of the usual chemicals used in sanitation practice. Ask for latest catalogs. Dept. P.W., Wallace & Tiernan Co., Newark 1, N. J.

Chem-O-Feeders for Automatic Chemical Feeding

400. For chlorinating water supplies, sewage plants, swimming pools and feeding practically any chemical used in sanitation treatment of water and sewage. Flow of water controls dosage of chemical; reagent feed is immediately adjustable. Starts and stops automatically. Literature from % Proportioneers, Inc. %, 96 Codding St., Providence 1, R. I.

Helpful Data on Hydrants

405. Specifications for standard AWWA fire hydrants with helpful instructions for ordering, installing, repairing, lengthening and using. Issued by M. & H. Valve & Fittings Co., Dept. P.W., Anniston, Ala.

Complete Data on Gates, Valves, Hydrants

414. Gate Valves. Double disc bronze mounted, sizes 2" to 72", hand, hydraulic, electric or pneumatic operating, rising or non-rising stem. Bulletin X. Address: Rensselaer Valve Co., Troy, N. Y.

It's Easy to Use This Leak Locator

426. Leak Locators. Again available to waterworks superintendents, the Globe line of leak locators, dipping needles and pipe finders. Several leaflets describing the original Geophone leak locator, Little Wonder pipe phone, and the Magnetite Dipping Needle. Globe Phone Mfg. Corp., Dept. P., Reading, Mass.

Find Your Leaks In a Jiffy

427. For tracing buried pipes and finding hidden leaks get detail of Allen-Howe Leak Detectors, Pipe Locators, Dipping Needle and Pipe Phones. Ask for new circular P.W. 6, Allen-Howe Electronics Corp., 150 Main St., Peabody, Mass.

What You Should Know About Meter Setting and Testing Equipment

431. The most complete catalog we have seen on setting and testing equipment for water meters—exquisitely printed and illustrated 48-page booklet P.W. you should have a copy of. Ask Ford Meter Box Co., Wabash, Ind.

Cast Iron Pipe and Fittings For Every Need

437. Cast iron pipe and fittings for water, gas, sewer and industrial service. Super - deLavaud centrifugally - cast and pit-cast pipe. Bell-and-spigot, U. S. Joint, flanged or flexible joints can be furnished to suit requirements. Write U. S Pipe and Foundry Co., Dept. P.W., Burlington, N. J.

Do You Have This Data On Cast Iron Pipe?

438. "Cast Iron Pipe and Fittings" is a well illustrated 44 page catalog giving full specifications for their complete line of Sand Spun Centrifugal Pipe, Fire Hydrants, Gate Valves, Special Castings, etc. Will be sent promptly by R. D. Wood Co., Dept. P.W., Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Makes Underground Pipe Installations Easy

444. One-man-operated Hydraulic Pipe Pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts and prices, ask for booklet S-117, Greenlee Tool Co., 2042 Columbia Ave., Rockford, Ill.

Interesting Facts About Transite Pipe

445. Two new illustrated booklets, "Transite Pressure Pipe" and "Transite Sewer Pipe" deal with methods of cutting costs of installation and maintenance of pipe lines and summarize advantages resulting from use of Transite pipes. Sent promptly by Johns-Manville Corp., Dept. P.W., 22 East 40th St., New York 16, N. Y.

Need a Water-Tight Pipe Joint?

449. Full information on "Hydro-Tite" jointing compound for bell and spigot pipe, together with specifications, instructions; and illustrations both on it and "Fibrex" sanitary joint packing are contained in handsome 48-page booklet. Address: Hydraulic Development Corp., Dept. P.W., 50 Church St., New York.

How to Estimate Quantity Of Joint Compound Needed

450. The uses of Tegul-Mineralead for bell and spigot pipe and G-K Sewer joint compound are described in a 16-page illustrated booklet issued by Atlas Mineral Products Co., Mertztown, Pa. Includes useful tables for estimating quantities needed.

Data on High Efficiency Well Water Systems

454. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for descriptive booklet P.W., Adv. Dept., Layne & Bowler, Inc., Box 186, Hollywood Station, Memphis 8, Tenn.

Want Clear, Soft, Iron-Free Water?

467. Water Softening. The use of the Spaulding Precipitator to obtain maximum efficiency and economy in water softening is described in this interesting technical booklet. Permutit Co., Dept. P.W., 330 W. 42nd St., New York 18, N. Y.

Are You Thinking About A Swimming Pool?

472. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

Have You a Water Conditioning Problem?

481. Installation-tested equipment for complete municipal and industrial systems or individual units. Illustrated and described in latest booklets from Dept. P.W., American Wells Works, Aurora, Ill.

How to Stabilize Lime Softened Water

498. Engineering Bulletin describes stabilizing lime-softened water by recarbonation, discusses gas production, washing, compressing, drying, and applying the CO (2). Infilco, Inc., 325 West 25th Place, Chicago 16, Ill.

Outdoor Water Service Devices That Do Not Freeze

506. Data on anti-freeze outdoor drinking fountains, hydrants, street washers, etc., contained in Catalog L. Sent promptly on request to Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio.

Here's Data on All Swimming Pool Needs

508. Well illustrated bulletin describes Filters, Water Softeners, Hydrogen Ion Plants and Complete Equipment for Swimming pools, etc. Copy sent on request by Dept. PW., Chemical Equipment Co., 223 Center Street, Los Angeles 54, Calif.

USE COUPON ON PAGE 63

Jobs for Engineers

The Maryland State Department of Health has a number of vacancies for sanitary engineers, as follows: Junior assistant, $2640-$3300; senior assistant, $2900-$3625; assistant, $3860-$4825. Write G. L. Hall, Chief Engineer, 2411 N. Charles St., Baltimore, Md.

An industrial hygiene engineer is needed by The Texas Co., 135 East 42nd St., N. Y. Write Dr. Newquist.

The City of Seattle, Wash., wants an experienced sanitary engineer, with training in public health; starting salary $440 per month. Write Dr. E. E. Palmquist, Public Safety Bldg., Seattle, Wash.

An engineer is wanted for city manager of Wayzata, Minn.; starting salary $350 per month. Write Donald Cleveland, Mayor.

The State of Virginia needs a civil-sanitary engineer to review plans and aid in training of operators. Salary to $4800. Write M. M. Sutherland, Div. of Budget, Governor's Office, Richmond, Va.

Two teaching jobs: In Southwest. School of Public Health wants Assoc. Prof. for all-around work, from sanitarians to laboratory, $4000 to $5000 for 9 months. Also for New York, a man to teach food and milk sanitation, water and sewage plant operation and supervision, etc. About same salary scale.

Sanitary engineer, 33; 10 years experience, civil and military; construction; and operation. Desires position involving research and investigation treatment and/or reclamation of industrial wastes. CL, care this magazine.

Personal News

William T. Ingram, senior sanitary engineer, U. S. Public Health Service, has been appointed Engineering Field Associate of the American Public Health Association. Mr. Ingram, who recently returned from service in the Mediterranean area, is charged with the development of a broad project involving greater and more useful utilization of sanitary engineers in the public health field.

Sewage Treatment

Bio-Activation Sewage Treatment.—An excellent 12-page booklet describing a method of sewage treatment by a combination of activated sludge and high capacity filters. Design data and factors are included, with a report of operating results. The design drawings are complete and instructive. Ask for Bulletin 259, American Well Works, Aurora, Ill.

Sewage Gas Control and Safety Equipment.—A very complete folder of booklets illustrating and describing Varec gas control and safety devices, and their installation. Catalog S-3, Vapor Recovery Systems Co., Compton, Calif.

Advertising Index

VOL. 78 PUBLIC WORKS No. 2

Published monthly by PUBLIC WORKS JOURNAL CORPORATION, 310 East 45th St., New York 17, N. Y.
Subscription Rates: U. S. A. and Possessions, Mexico and Cuba, $3.00; Canada, $3.50. All other countries $4.00.

FEBRUARY, 1947